U.S. AIR FORCE

REMEDIAL INVESTIGATION/FEASIBILITY STUDY
WILLIAMS AIR FORCE BASE, ARIZONA

FINAL
RECORD OF DECISION
OPERABLE UNIT 1

AIR FORCE BASE CONVERSION AGENCY
WILLIAMS AIR FORCE BASE, ARIZONA 85206

APRIL 1994

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KN/1385/WP1385.COV/04-12-94/D3

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List of Acronyms

ADEQ	Arizona Department of Environmental Quality
ADWR	Arizona Department of Water Resources
AFB	Air Force Base
ARAR	applicable or relevant and appropriate requirement
ATC	Air Training Command
ATSDR	Agency for Toxic Substances and Disease Registry
AV	AeroVironment, Inc.
bls	below land surface
BHC	beta-hexachlorobenzene
BTEX	benzene, toluene, ethyl benzene, and xylene
CAG	Carcinogenic Assessment Group
CDI	chronic daily intake
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CPF	carcinogenic potency factor
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltricholoroethane
DEIS	Disposal Environmental Impact Statement
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
EE/CA	Engineering Evaluation/Cost Analysis
Energy Systems	Martin Marietta Energy Systems, Inc.
EPA	U.S. Environmental Protection Agency
ES	Engineering-Science
FFA	Federal Facilities Agreement
FS	feasibility study
FSP	Field Sampling Plan
GI	gastrointestinal
HAZWRAP	Hazardous Waste Remedial Actions Program
HBFH	high boiling fuel hydrocarbons
HBGL	health-based guidance level
HEAST	Health Effects Assessment Summary Tables
HI	hazard index

HSP	Health and Safety Plan
HQ	hazard quotient
ILCR	incremental lifetime cancer risk
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
IT	IT Corporation
LOEL	lowest observed effect level
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
msl	mean sea level
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
NOEL	no observed effect level
O&M	operation and maintenance
OU-1	Operable Unit 1
OU-2	Operable Unit 2
OU-3	Operable Unit 3
PAH	polynuclear aromatic hydrocarbons
PCE	tetrachloroethane
pCi/g	picoCuries per gram
QAPP	Quality Assurance Project Plan
RAB	Restoration Advisory Board
RAO	remedial action objectives
RCRA	Resource Conservation and Recovery Act
RD/RA	remedial design/remedial action
RfD	reference dose
RG	remediation goal
RI	remedial investigation
RME	reasonable maximum exposure
ROD	Record of Decision
RWCD	Roosevelt Water Control District
SARA	Superfund Amendments and Reauthorization Act
SVOC	semivolatile organic compound
TBC	to be considered

List of Acronyms (Continued)

TCLP	Toxicity Characteristic Leaching Procedure
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TRC	Technical Review Committee
TWG	Technical Working Group
UCL	upper confidence limit
USAF	United States Air Force
USGS	U.S. Geological Survey
UST	underground storage tank
VOC	volatile organic compound

1.0 Declaration

1.1 Site Name and Location

Williams Air Force Base (AFB) is located in Maricopa County, east of Chandler, Arizona (Figure 1-1). Operable Unit 1 (OU-1) of the Williams AFB, National Priorities List (NPL) site comprises the individual sites listed in Table 1-1.

1.2 Statement of Basis and Purpose

This Record of Decision (ROD) presents the selected remedial action for the sites that compose OU-1 at Williams AFB, which are listed in Table 1-1. The ROD was developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendment and Reauthorization Act (SARA), and, to the extent practicable, the National Contingency Plan (NCP). This decision is based on the Administrative Record for this operable unit.

The U.S. Environmental Protection Agency (EPA) and the State of Arizona concur with the selected remedy for OU-1.

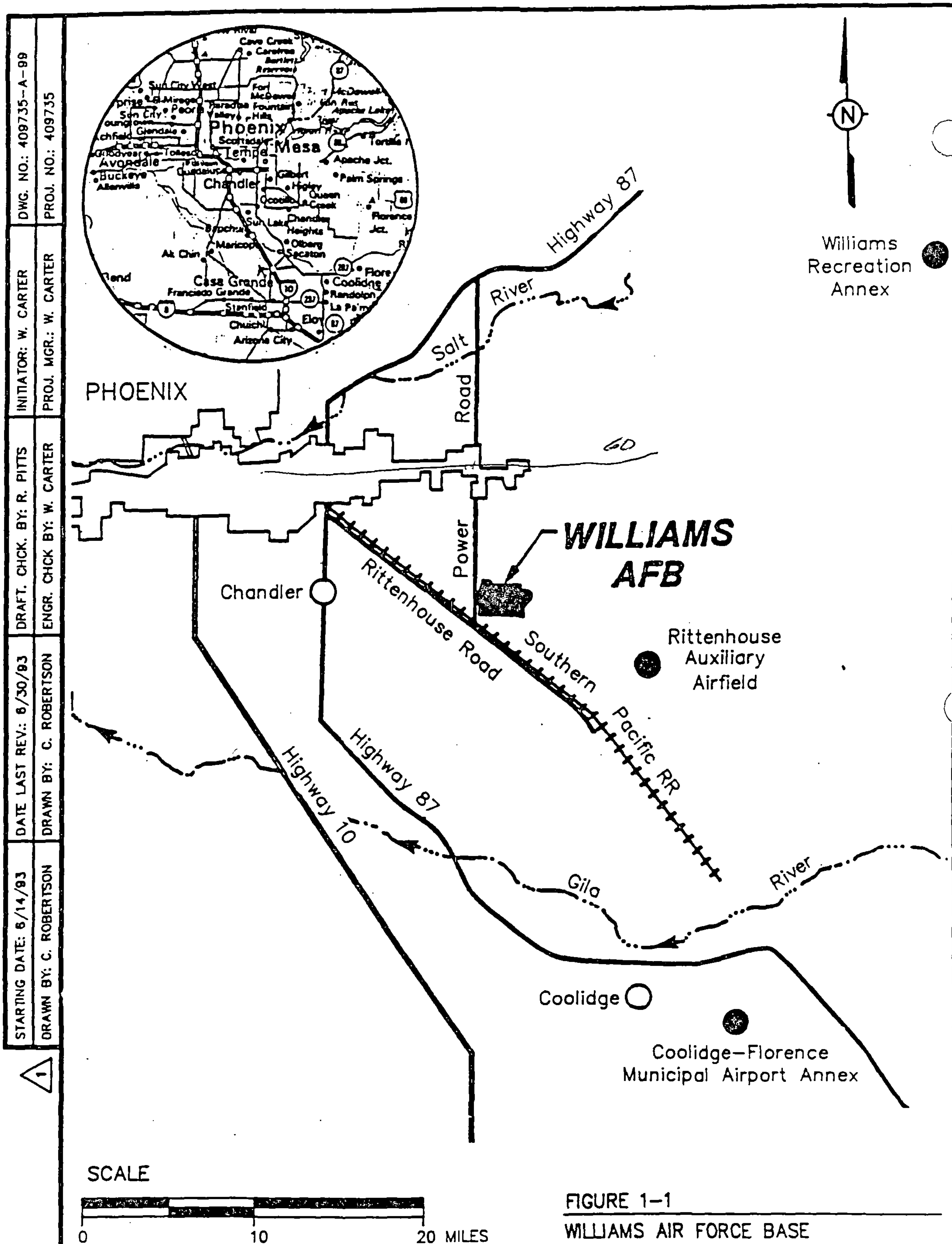
1.3 Assessment of the Site

Dieldrin and beryllium are present in Landfill (LF-04) surface soils at concentrations above remediation goals (RG). Existing conditions at the site have been determined to pose a total incremental lifetime cancer risk (ILCR) of 2.03×10^{-5} for future residential exposures and 1.3×10^{-5} for current occupational exposures to contaminated surface soils. The most significant exposure pathways are dermal contact with soil, incidental ingestion of soil, and inhalation of fugitive dust. Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health and the environment.

1.4 Description of the Selected Remedy

OU-1 currently includes the ten sites listed in Table 1-1 and presented in Figure 1-2. Operable Unit 2 (OU-2) is defined as the groundwater contamination and the first 25 feet in depth of soil at the Liquid Fuels Storage Area (ST-12). Operable Unit 3 (OU-3) has been newly established to accomplish the following:

- Characterize environmental contaminant conditions and health risks associated with the Southwest Drainage System (SD-09), which was expanded to include a



SOURCE: U.S. GEOLOGICAL SURVEY MAP

FIGURE 1-1

WILLIAMS AIR FORCE BASE AND VICINITY

INTERNATIONAL TECHNOLOGY CORPORATION

Table 1-1

Site List
Operable Unit 1
Williams Air Force Base

Site Code	Site Description
LF-04	Landfill
FT-03	Fire Protection Training Area No. 1
SD-10	Northwest Drainage System
RW-11	Radioactive Instrumentation Burial Area
DP-13	Pesticide Burial Area
SS-01	Hazardous Materials Storage Area
ST-05	Building 789, 5 USTs
ST-06	Building 725, 2 USTs
ST-07	Building 1086, 2 USTs
ST-08	Building 1085, 3 USTs

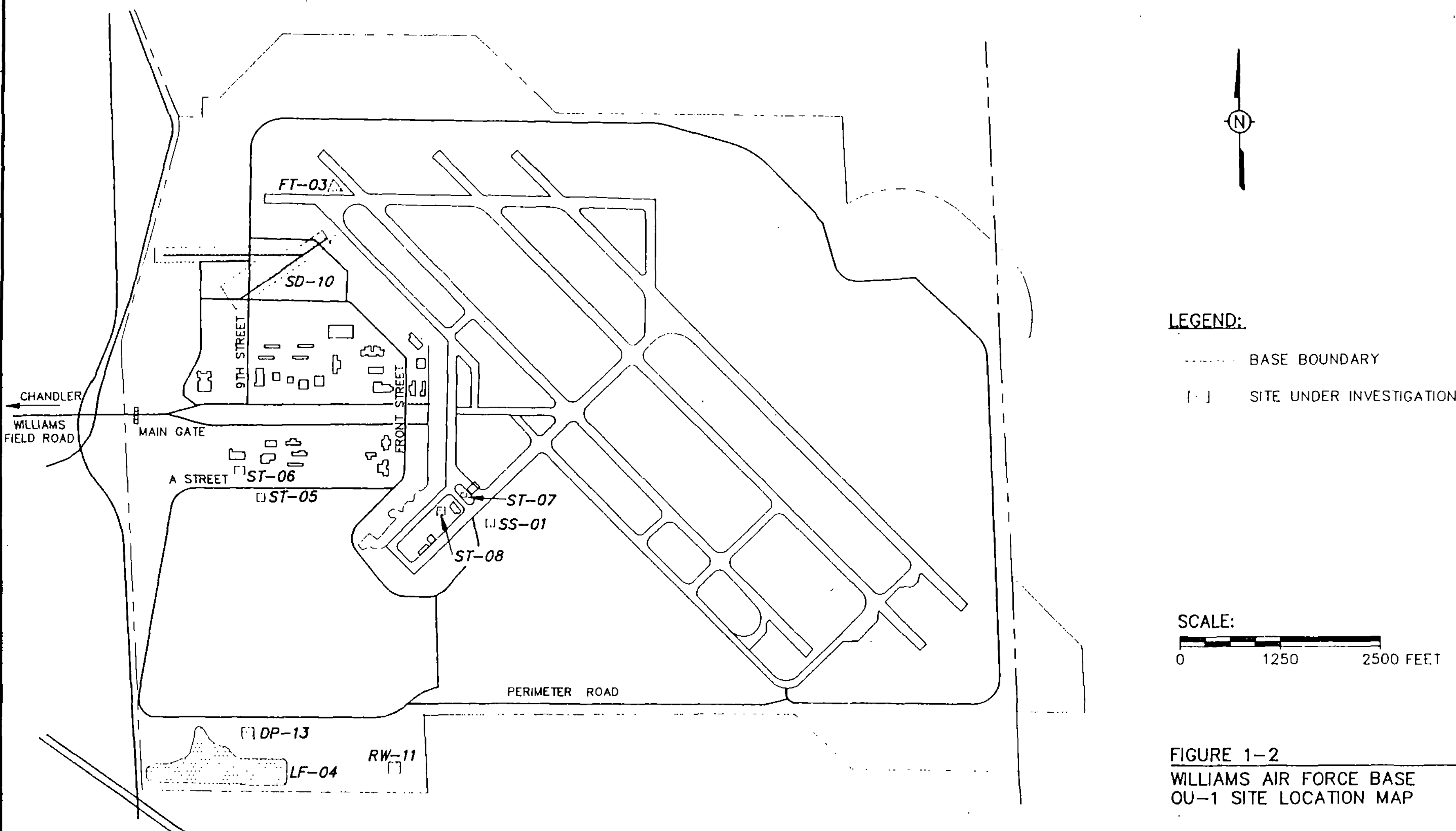


FIGURE 1-2
WILLIAMS AIR FORCE BASE
OU-1 SITE LOCATION MAP

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 5/13/93 | DATE LAST REV.: | DRAFT. CHCK. BY: R. PITTS | INITIATOR: T. KOVALCSON | DWG. NO.: 409735-B-96
DRAWN BY: D. HIGGS | DRAWN BY: | ENGR. CHCK. BY: T. KOVALCSON | PROJ. MGR.: W. CARTER | PROJ. NO.: 409735

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storm drain line, five oil/water separators northeast from the headworks to Building 53, and a capped portion of the drainage system just downstream of the headworks.

- Characterize environmental contaminant conditions and health risks associated with deep soils below 25 feet in depth at ST-12.
- Present a comprehensive ecological risk assessment for the whole of Williams AFB in the OU-3 remedial investigation (RI) report.
- Establish final remedial actions for Fire Protection Training Area No. 2 (FT-02) in the OU-3 feasibility study (FS) and ROD.

Additional operable units may be identified in the future as a result of these and other investigations. Also, because Williams AFB has been closed, additional operable units may be utilized to expedite remedial action activities in accordance with Base reuse goals.

The description of the selected remedy for each of the ten sites within OU-1 is presented in the following sections.

1.4.1 Landfill (LF-04)

The selected remedy for LF-04 involves the following major components:

- A permeable cap over the contaminated surface soils to limit exposure by potential receptors and control natural erosion processes
- An interceptor trench around the perimeter of the capped area to aid in collecting and proper routing of any stormwater runoff
- A fence around the perimeter of the interceptor trench and warning signs posted to notify potential land users of the presence of the cap covering contaminated surface soil
- Postclosure care for 30 years, including landfill cover maintenance, annual soil monitoring, semiannual (every 6 months) groundwater monitoring, and maintenance of all associated monitoring equipment to ensure the effectiveness of the remedial action
- Land-use restrictions to protect the integrity of the landfill cover and the operation of the groundwater monitoring system.

The remedy accomplishes the primary remediation goal of overall protection of human health and the environment by providing a barrier between the contaminated soil and any potential human or environmental receptors.

1.4.2 Fire Protection Training Area No. 1 (FT-03)

No action.

1.4.3 Northwest Drainage System (SD-10)

No action.

1.4.4 Radioactive Instrumentation Burial Area (RW-11)

No further action.

1.4.5 Pesticide Burial Area (DP-13)

No further action.

1.4.6 Hazardous Materials Storage Area (SS-01)

No action.

1.4.7 Underground Storage Tanks (UST) at Building 789 (ST-05)

No further action.

1.4.8 USTs at Building 725 (ST-06)

No further action.

1.4.9 USTs at Building 1086 (ST-07)

No further action.

1.4.10 USTs Building 1085 (ST-08)

No further action.

1.5 Statutory Determinations - Landfill (LF-04)

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. This remedy uses permanent solutions and alternative treatment technologies to the maximum extent practicable for this site. However, because treatment of the principal threats of the site was not found to be practicable, this remedy does not satisfy the statutory preference for treatment as a principal element of the remedy. The size of the landfill, the fact that there are no on-site hot spots that represent the major sources of contamination, and the fact that the contaminated surface soils cover buried landfill wastes preclude a remedy in which contaminants could be excavated and treated effectively.

Because this remedy will result in hazardous substances remaining on site above health-based levels, a review will be conducted within 5 years after completion of the remedial action to ensure that the remedy continues to provide adequate protection for human health and the environment.

1.6 Declaration Statement

No unacceptable health risks are present at any of the following sites, as calculated under a residential exposure scenario during the risk assessment. Therefore, 5-year periodic reviews are not required for these sites.

1.6.1 Fire Protection Training Area No. 1 (FT-03)

No remedial action is necessary to ensure protection of human health and the environment.

1.6.2 Northwest Drainage System (SD-10)

No remedial action is necessary to ensure protection of human health and the environment.

1.6.3 Radioactive Instrumentation Burial Area (RW-11)

No further remedial action is necessary to ensure protection of human health and the environment. A previous response action at the site removed the source of contamination and eliminated the need to conduct additional remedial actions.

1.6.4 Pesticide Burial Area (DP-13)

No further remedial action is necessary to ensure protection of human health and the environment. A previous response action at the site removed the source of contamination and eliminated the need to conduct additional remedial actions.

1.6.5 Hazardous Materials Storage Area (SS-01)

No remedial action is necessary to ensure protection of human health and the environment.

1.6.6 USTs at Building 789 (ST-05)

No further remedial action is necessary to ensure protection of human health and the environment. A previous response action at the site removed the source of contamination and eliminated the need to conduct additional remedial actions.

1.6.7 USTs at Building 725 (ST-06)

No further remedial action is necessary to ensure protection of human health and the environment. A previous response action at the site removed the source of contamination and eliminated the need to conduct additional remedial actions.

1.6.8 USTs at Building 1086 (ST-07)

No further remedial action is necessary to ensure protection of human health and the environment. A previous response action at the site removed the source of contamination and eliminated the need to conduct additional remedial actions.

1.6.9 USTs at Building 1085 (ST-08)

No further remedial action is necessary to ensure protection of human health and the environment. A previous response action at the site removed the source of contamination and eliminated the need to conduct additional remedial actions.

rec'd June 1

This Record of Decision for Operable Unit Number One at Williams Air Force Base, Arizona may be executed and delivered in any number of counterparts, each of which when executed and delivered shall be deemed to be an original, but such counterparts shall together constitute one and the same document.

April 20, 1994

Alan K. Olsen, Director
U.S. Air Force, Base Conversion Agency

Date

5.2.94

John C. Wise, Deputy Regional Administrator
EPA, Region IX

Date

5.13.94

Edward Z. Fox, Director
Arizona Department of Environmental Quality

Date

5/18/94

Rita Pearson, Director
Arizona Department of Water Resources

Date

2.0 Decision Summary

2.1 Site Name, Location, and Description

Williams AFB was a flight training base located in Maricopa County, Arizona approximately 30 miles southeast of Phoenix and just east of Chandler (Figure 1-1). The Base, commissioned as a flight training school, was constructed on 4,127 acres of government land in 1941. Runway and airfield operations, industrial areas, housing, and recreational facilities are located on the Base. Training activities started after construction, with jet aircraft training beginning in 1949. The Base was closed September 30, 1993.

This ROD addresses remedial actions for OU-1, which comprises the sites presented in Table 1-1 and Figure 1-2.

Williams AFB is relatively isolated from any large metropolitan area. It is surrounded primarily by agricultural land in a valley that has had a long history of intensive agricultural use, predominantly for crops of citrus, cotton, and alfalfa. Smaller urban areas such as Mesa, Chandler, Gilbert, and Apache Junction are located 5 to 15 miles northeast and northwest of the Base. The Queen Creek and Chandler Heights areas are approximately 5 miles south and west of the Base boundary, respectively. Table 2-1 lists these towns and others with distance and direction from Williams AFB, and the population of the towns are included. These areas are separated from the Base by cultivated and uncultivated land.

During its active status, 3,029 military personnel and 869 civilian employees were stationed at the Base. Many of the military personnel lived off Base in one of the surrounding areas. The total population actually living on Base, including dependents, was approximately 2,700. On an average workday, the population of the Base increased to more than 5,000 because of the influx of both civilian employees and military personnel living off base (Cost Branch Controller Division, 1987).

A development plan for the region (Sunregion Associates, 1987), if implemented, will dramatically alter the region surrounding Williams AFB. The portions of the development plan of most importance to the Base are the East Mesa Subarea Plan and the Queen Creek-Chandler Heights Plan. The former proposes development for portions of the City of Mesa, the Town of Gilbert, the City of Apache Junction, and the land area north of Williams AFB. The proposed land area for the Queen Creek-Chandler Heights Plan is east of Chandler, just

Table 2-1

Cities Surrounding Williams Air Force Base

City	Direction Relative to Williams AFB	Distance from Williams AFB (miles)	Population[a]
Apache Junction	North-Northeast	10	18,100
Chandler	West	5	90,533
Gilbert	Northwest	5	29,188
Mesa	North-Northwest	15	288,091
Queen Creek	South	5	2,667
Tempe	Northwest	20	141,865
Phoenix	Northwest	25	893,983

[a]April 1, 1990 Census, Public Law Tape 94-171.

south of the Base in the approximate location of the Town of Queen Creek. The plan is to develop the proposed area residentially and commercially for a 25-year period. If implemented, this development will dramatically impact the demographics and population around the Base. In addition, the closure of Williams AFB could also impact the region.

There are no major surface water bodies within a 10-mile radius of the Base. The Base lies between the 100-year and 500-year flood level for streams in the Gila River Basin (U.S. Department of Housing and Urban Development, 1979). Storm drainage on the Base is directed to a combination of open channels used to drain most of the Base and underground drainage structures. Storm drainage from the Base flows either to the Roosevelt Water Control District (RWCD) floodway that flows southward in the vicinity of the Base or directly to the floodway west of the Base, or into the wastewater treatment plant.

There are at least 90 domestic permitted wells within a 3-mile radius of the Base. These wells are not affected by the contamination at OU-1. The Base currently performs periodic monitoring and sampling of groundwater wells on the Base in the vicinity of LF-04 and ST-12.

The climate of Williams AFB is similar to that of Phoenix and the rest of the Salt River Valley. The temperature ranges from very hot in the summer to mild in winter. Rain comes mostly in two seasons: from late November until early April, and in July and August. Average annual precipitation is approximately 7.1 inches. Humidity ranges from approximately 30 percent in winter to 10 percent in summer. Williams AFB is also characterized by light winds. Evapotranspiration rates in the area exceed 65 inches per year.

Williams AFB lies in the eastern portion of the Basin and Range Physiographic Lowlands Province of south-central Arizona, which is located in the Salt River Valley. The local topography is controlled by large-scale normal faulting that has resulted in the formation of broad, flat, alluvial-filled valleys separated by steep isolated hills and mountain ranges. Arizona Department of Water Resource's hydrologic maps show the Base bounded to the north by the Usery Mountains, to the east by the Superstition Mountains, to the south by the Santan Mountains, and to the west by South Mountain.

The topography of the Base slopes gently to the west with a generally less than 1 percent grade. Elevations range from 1,326 feet above mean sea level (msl) on the west side of the Base to 1,390 feet above msl at the southeast corner of the Base.

According to Laney and Hahn (1986), the area of the Base is underlain by six geologic units: crystalline rocks, extrusive rocks, red unit, lower unit, middle unit, and upper unit. The crystalline and extrusive rocks compose the surrounding mountains and the basement complex underlying the consolidated and unconsolidated sediments of the valley. The four units overlying the basement complex are of sedimentary origin and have the surrounding mountains and local drainage as their source areas.

The red unit immediately overlies the basement complex and is composed of well-cemented breccia, conglomerate, sandstone, and siltstone of continental origin with interbedded extrusive flow rocks.

The lower unit overlies the red unit and consists of playa, alluvial fan, and fluvial deposits with evaporites and interbedded basaltic flows present in lower sections (Laney and Hahn, 1986).

The middle unit overlies the lower unit and is composed of playa, alluvial fan, and fluvial deposits with no associated evaporites. The middle unit received its sediment primarily from the Salt River, whereas the red and lower units had the local mountains as the principal source.

The youngest unit in the stratigraphic sequence is referred to as the upper unit. This unit consists of channel, floodplain, terrace, and alluvial fan deposits of largely unconsolidated gravel, sand, silt, and clay.

Geological conditions beneath OU-1 were characterized by using a combination of continuous coring and geophysics. The deposits encountered during drilling at OU-1 are correlative to the upper unit of Laney and Hahn (1986) and possibly to the extreme upper section of their middle unit.

There are two major soil associations found in the vicinity of Williams AFB. The Mohall-Contine Association is found over much of the Base, and the Gillman-Estrella-Avondale Association is found at the southern boundary of the Base. The Mohall-Contine and the Gillman-Estrella-Avondale Associations have generally the same characteristics, being well drained and nearly level with slopes of less than 1 percent.

Because of a decline in the water table produced by excessive irrigation withdrawals over the past 50 years, an extensive vadose zone has been produced in the vicinity of Williams AFB. The low rainfall and high evapotranspiration rate of the area also contribute to a very low potential for recharge to occur through the soil comprising the vadose zone.

Groundwater beneath OU-1 sites is encountered at depths ranging from 180 to 250 feet. IT Corporation (IT) and previous contractors have placed monitoring wells at two of the OU-1 sites (LF-04 and FT-03) to monitor two zones of the aquifer. At both sites, the aquifer zones are considered to be part of the same aquifer system and are referred to as the upper and lower portions of the aquifer.

Groundwater elevation contour maps indicate that groundwater flows to the north and east on a Base-wide scale. This finding is consistent with other groundwater elevation contour maps presented for the area (Laney and Hahn, 1986; AeroVironment, Inc. [AV], 1987). Groundwater flows to east at LF-04 and to the north at FT-03. Hydraulic gradients range from 4.30×10^{-3} to 8.50×10^{-3}. Using hydraulic conductivity data from ST-12 and assuming a porosity of 0.30, groundwater flow velocity over the Base in the lower portions of the aquifer is calculated to range from 1.4×10^{-3} to 2.9×10^{-1} feet/day.

2.2 Site History and Enforcement Activities

Williams AFB was a flight training base that opened in 1942. It was immediately commissioned as a flight training school, and training activities with jet aircraft began in 1949. Throughout its history, pilot training was the primary activity at Williams AFB. At various times, bombardier, bomber pilot, instrument bombing specialist, and fighter gunnery training schools were also housed on Base. Over the years, a wide variety and large number of aircraft have been housed at Williams AFB.

The Installation Restoration Program (IRP) was implemented by the U.S. Department of Defense (DOD) in 1980 to identify and control environmental contamination from past hazardous materials use and disposal activities at United States Air Force (USAF) installations. The IRP is DOD's equivalent of the national Superfund program. SARA, passed by Congress in 1986, required cleanup of federal facilities to meet Superfund requirements.

IRP guidance was received at Williams AFB in July 1983 and the initial assessment study (designated as Phase I) was completed by Engineering-Science (ES) in 1984. Based on a review of available records pertaining to chemical handling and disposal practices, interviews with site personnel, and a site survey of activities at Williams AFB, the study identified the following nine potential sites where hazardous materials have been handled or disposed:

- Landfill
- Fire Protection Training Area No. 1
- Fire Protection Training Area No. 2
- Northwest Drainage System
- Southwest Drainage System
- Radioactive Instrumentation Burial Area
- Pesticide Burial Area
- Hazardous Materials Storage Area
- Liquid Fuels Storage Area.

A second investigation (designated as Phase II) was conducted by AV from September 1984 to December 1985. This investigation was initiated to confirm the information in the ES report and to verify the presence and quantify the extent of contamination. In 1987, AV completed an additional investigation (Phase II, Stage 2) to define the most likely pathways for contaminant migration from each site and to confirm the presence or absence of contamination along those pathways. Some of the analytical data utilized in this ROD were collected during this Phase II, Stage 2 investigation.

In 1987, as a result of AV investigations, IT, under a contract with Martin Marietta Energy Systems, Inc. (Energy Systems) through the Hazardous Waste Remedial Actions Program (HAZWRAP) (IT, 1987a), performed a simple remedial action. This activity involved designing soil cementing and a concrete cap for approximately 350 feet of the uppermost portion of the Southwest Drainage System. Plans and specifications were issued in September 1987 (IT, 1987b) and the work was completed that year.

In October 1988, the Air Training Command (ATC) contracted Energy Systems and its subcontractor, IT, through the U.S. Department of Energy (DOE) to complete the RI/FS, Proposed Plan, and ROD at Williams AFB. As part of these efforts, a Work Plan (IT, 1991a); a Quality Assurance Project Plan (QAPP) (IT, 1991b), which includes a Health and Safety Plan (HSP); and a Field Sampling Plan (FSP) (IT, 1991c) were issued. The continuation of the RI was initiated in January 1989. The sites investigated include the nine original sites plus four underground storage tank (UST) sites. The complete list of all Williams AFB sites then consisted of the following:

- Landfill (LF-04)
- Fire Protection Training Area No. 1 (FT-03)
- Fire Protection Training Area No. 2 (FT-02)
- Northwest Drainage System (SD-10)
- Southwest Drainage System (SD-09)
- Radioactive Instrumentation Burial Area (RW-11)
- Pesticide Burial Area (DP-13)
- Hazardous Materials Storage Area (SS-01)
- Liquid Fuels Storage Area (ST-12)
- USTs at four areas (ST-05, ST-06, ST-07, ST-08).

Williams AFB was added to the NPL on November 21, 1989. The NPL primarily serves as an information tool for the EPA to identify sites that possibly warrant further investigation and remedial action.

As a consequence of inclusion on the NPL listing, negotiations were completed and a Federal Facilities Agreement (FFA) was signed on September 21, 1990. The FFA establishes a cooperative and participatory framework among the federal and state agency members, defines their roles and responsibilities, and develops a process to resolve any disputes that may arise during the study and execution phases of the IRP. In addition, the FFA prioritizes and schedules the investigation and remedial actions at Williams AFB through the designation of operable units that aid in managing these activities. Parties to the FFA include the USAF, the EPA, the Arizona Department of Environmental Quality (ADEQ), and the Arizona Department of Water Resources (ADWR).

A ROD for OU-2 was signed in December 1992. The selected remedy involves a combination of soil vapor extraction with bioenhancement to remediate affected soils to a depth of 25 feet, and groundwater extraction and treatment via air stripping with emission abatement to address the contaminated groundwater. The selected remedy will be implemented until the chemicals of concern that present an unacceptable risk to human health or the environment in soil (benzene, 1,4-dichlorobenzene) and groundwater (benzene, naphthalene, toluene) are reduced to concentrations below final remediation goals.

History of past waste practices, environmental investigations, enforcement activities, and remedial actions is presented for each site within OU-1 in the following sections.

2.2.1 Landfill (LF-04)

2.2.1.1 Site Description and History

The Landfill (LF-04) is located in the southwest corner of the Base (Figure 1-1) and is adjacent to the sewage treatment plant (Figure 2-1). During its operation from 1941 to 1976, LF-04 received mainly domestic trash and garbage. LF-04 also received wood, metal, brush, and construction debris. As with many sanitary landfills, solvents and chemicals may have been disposed of along with the trash. Also, prior to 1973, dried sludge from the sewage treatment plant was taken to LF-04 (ES, 1984). Since closure of LF-04 in 1976, all newly generated wastes have been transported off Base for disposal by a contractor (ES, 1984).

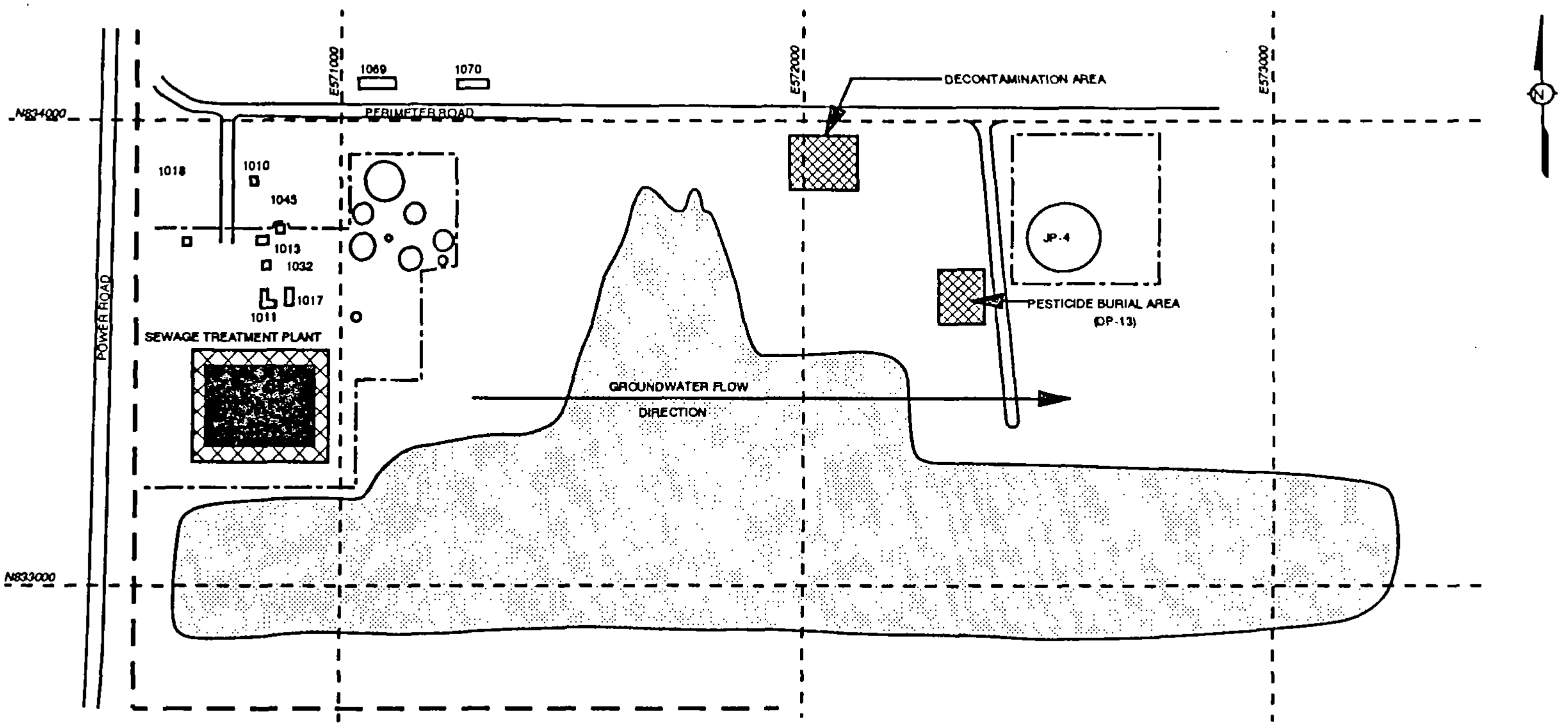
The Landfill was constructed by digging unlined trenches 15 to 20 feet deep and then filling them with refuse to approximately 10 to 15 feet above the original ground level for a total fill depth of 25 to 35 feet. Filling began in the southwest corner of the site and progressed to the area east of the sewage treatment plant, followed by filling in the southeast corner of the site. During the 1940s and 1950s, material deposited at LF-04 was routinely burned (ES, 1984).

The top surface of LF-04 is irregular because of differential trench settlement. There is also a small amount of waste (brush, metal, and wood) that is not buried.

2.2.1.2 Investigations

ES, under contract to the USAF, completed Phase I of the IRP on Williams AFB in February 1984. Phase I used available written and oral information to identify and assess past disposal and spill sites. The Phase I document identified LF-04 as an area on Williams AFB where past hazardous material handling and disposal facilities may have resulted in contamination (ES, 1984). A records search evaluated information such as Base maps, aerial photographs, disposal records, hazardous material inventories, spill records, and environmental documents and permits. Also, former and present Base personnel were interviewed to determine and assess disposal and spill sites.

Phase I was followed by Phase II, Stage 1 field work, during which AV installed seven boreholes (three shallow, four deep) around the periphery of the landfill to a maximum depth of 83.5 feet and collected and analyzed 52 soil samples. During the Phase II, Stage 2 investigation, AV installed and sampled six groundwater monitoring wells around the periphery of the landfill. One of these wells (LA-06) was completed in the uppermost section



LEGEND:

BASE BOUNDARY

LANDFILL

SCALE:

0 250 500 FEET

FIGURE 2-1

WILLIAMS AIR FORCE BASE
LANDFILL AREA (LF-04)

INTERNATIONAL TECHNOLOGY CORPORATION

of the aquifer while the remaining five were advanced to the lower section of the aquifer. No soil samples were taken from LF-04 during the Phase II, Stage 2 investigation.

During the RI, IT installed an additional 6 wells around the periphery of the landfill, bringing the total to 12. These wells were installed in the upper section of the aquifer to obtain additional groundwater monitoring data hydraulically upgradient and downgradient of LF-04 and to determine groundwater characteristics. Also, ten surface soil samples were collected from the landfill surface in December 1991 for analysis.

Monitoring well and soil boring locations are presented in Figure 2-2. This figure also details concentrations of surface soil samples.

2.2.1.3 Other Actions

No other action has been taken at this site.

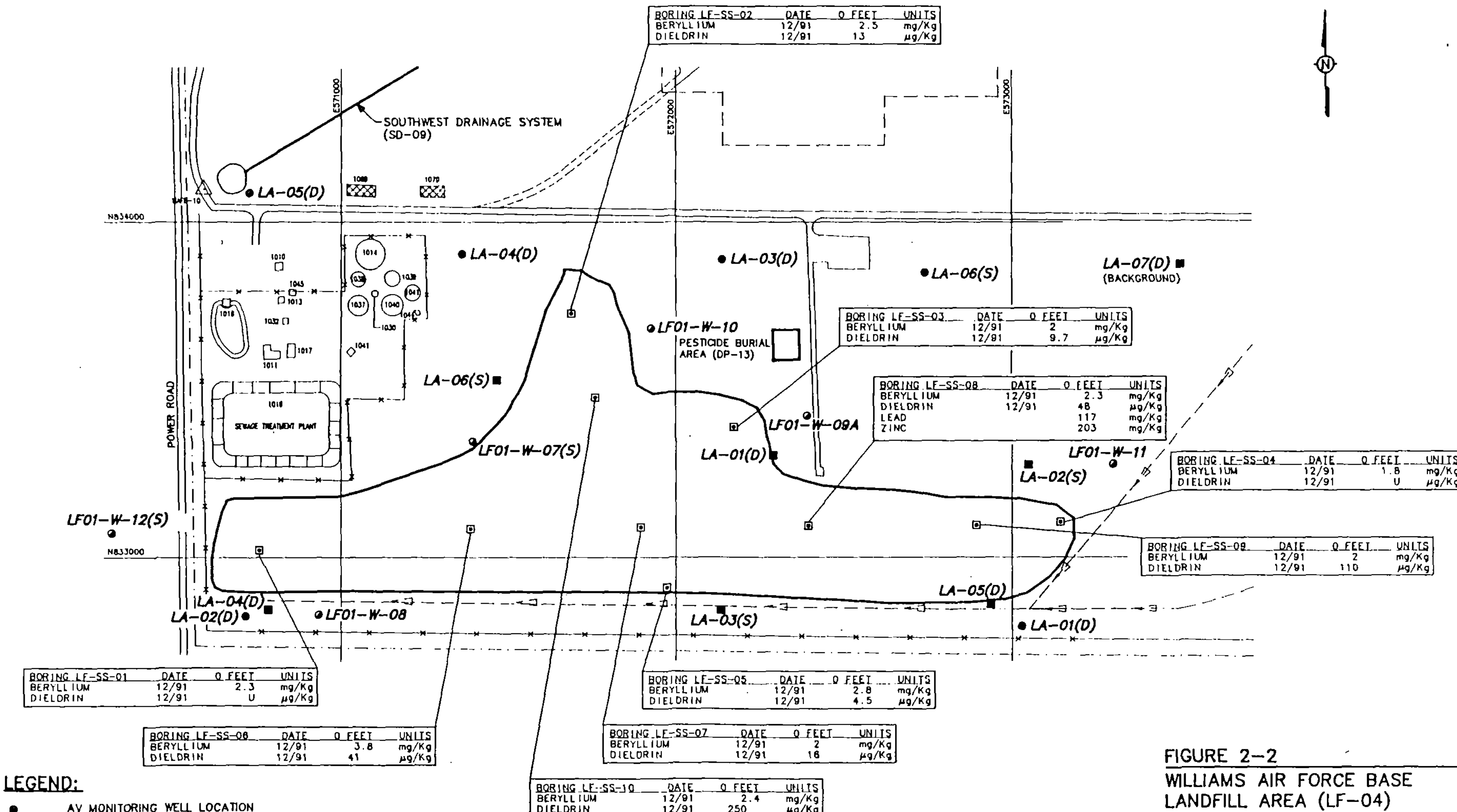
2.2.2 Fire Protection Training Area No. 1 (FT-03)

2.2.2.1 Site Description and History

There are two known areas where fire protection training activities have been conducted on the Base (FT-03 and FT-02). The original fire protection training area (FT-03) was believed to be located on the northwest portion of the Base between the northwest-southeast runway (12R), Taxiway No. 5, and the northern part of the golf course (Figure 2-3). The precise location of FT-03 originally was uncertain because its last use was more than 30 years ago. Its actual location, also shown in Figure 2-3, was finally confirmed by interviews and computer-enhanced aerial photographs (IT, 1990a).

Operations at FT-03 are believed to have started in the early 1940s and were concluded in 1958. The site was reportedly used for fire training in which fuel, waste oils, solvents, and other flammable materials were burned during the training exercises (ES, 1984). Water was applied to the ground surface before each burn to minimize the total impact of the waste application. Any residual (unburned) materials and fire extinguishing agents may have volatilized or percolated into the ground.

Although no information was available concerning the volume of wastes used and the frequency of burns, it is believed that the number of training exercises conducted during the



LEGEND:

- ● AV MONITORING WELL LOCATION AND NUMBER
- ◑ IT MONITORING WELL LOCATION AND NUMBER
- ■ AV SOIL BORING LOCATION (APPROXIMATE) AND NUMBER
- ⊡ IT SURFACE SOIL SAMPLE LOCATION (APPROXIMATE)
- (S) DENOTES SHALLOW BORING
- (D) DENOTES DEEP WELL/BORING
- U NONE DETECTED
- BASE BOUNDARY
- LANDFILL

NOTE:

SAMPLES LF-SS-06 THROUGH LF-SS-10 ARE COMPOSITE SAMPLES

SCALE: 0 300 600 FEET

FIGURE 2-2
WILLIAMS AIR FORCE BASE
LANDFILL AREA (LF-04)
CONCENTRATION IN
SURFACE SOIL SAMPLES

INTERNATIONAL TECHNOLOGY CORPORATION

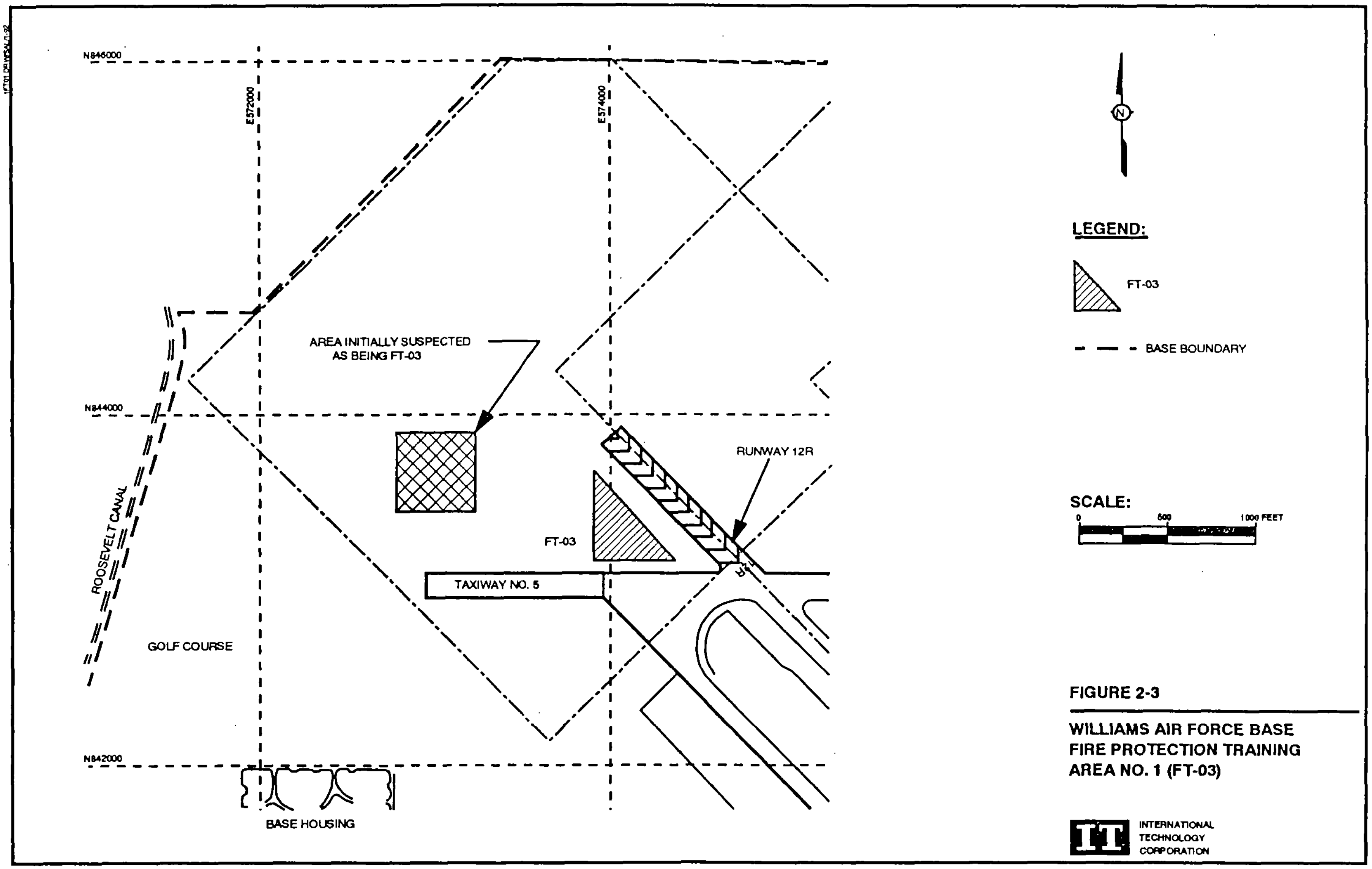


FIGURE 2-3

WILLIAMS AIR FORCE BASE
FIRE PROTECTION TRAINING
AREA NO. 1 (FT-03)

1940s were lower than in later years when training activities received more emphasis (ES, 1984).

2.2.2.2 Investigations

The Phase I document identified FT-03 as an area at Williams AFB where previous activities may have resulted in contamination (ES, 1984). No field work was performed at FT-03 during the Phase II, Stage 1 work; however, during the Stage 2 investigation, AV drilled 12 soil borings to a maximum depth of 40 feet and collected and analyzed 56 soil samples as shown in Figure 2-4. The area initially investigated by AV is approximately 500 feet east of the golf course and 1,500 feet north of Base housing. AV also installed three deep groundwater monitoring wells (F1-01, F1-02, and F1-03) and collected nine groundwater samples.

Because no evidence of soil or groundwater contamination was found during the Phase II, Stage 2 investigation of this area, historical photographs were examined and additional inquiries were made of retired Base personnel familiar with the original use of this area. These personnel indicated that FT-03 was located between the northwest-southeast runway (12R) and Taxiway No. 5 (Figure 2-3). This location was confirmed using computer-enhanced aerial photographs taken during 1949, 1954, 1957, and 1979.

Analysis of aerial photographs taken in 1957 showed that FT-03 was comprised of three burn areas (IT, 1990a). These areas are located north of Taxiway No. 5 and west of Runway 12R. Based on aerial photographs, in May 1989, IT installed two boreholes at FT-03 to a maximum depth of 150 feet and collected and analyzed 12 soil samples from the boreholes. In addition, IT collected one water sample from each monitoring well in February 1989.

After collecting groundwater elevation data for more than 12 months, and conducting several rounds of groundwater sampling and analysis which detected limited contamination, Wells F1-02 and F1-03 were abandoned during 1991, and F1-01 was converted to a piezometer for continued groundwater level measurements. This was agreed to by all parties to the FFA.

In September 1993, three surface soil samples were collected and analyzed for semivolatile organic compounds (SVOC) and metals to confirm the presence or absence of contaminants in surface soil.

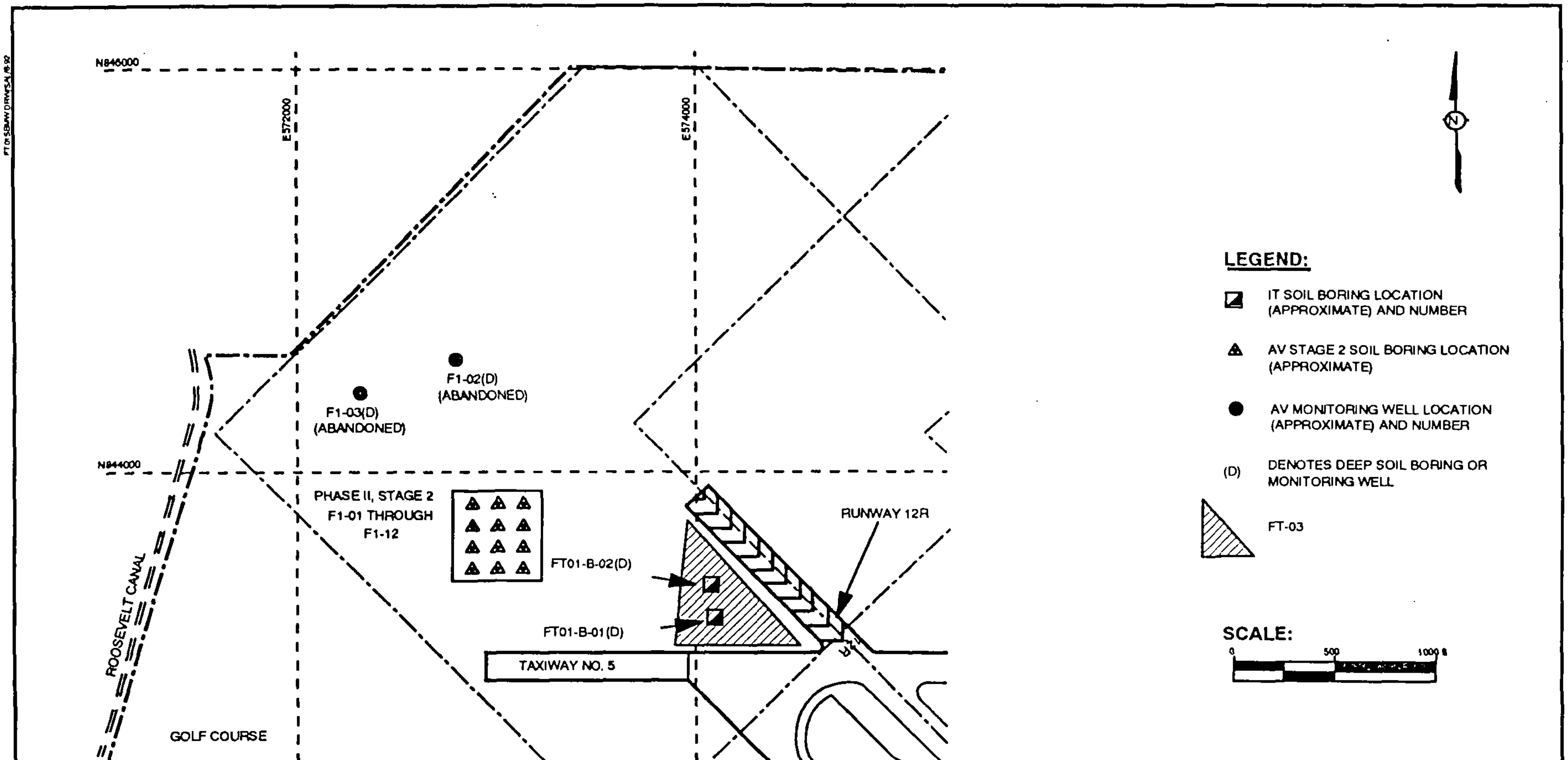


FIGURE 2-4

WILLIAMS AIR FORCE BASE
FIRE PROTECTION TRAINING
AREA NO. 1 (FT-03)
SOIL BORING LOCATIONS

INTERNATIONAL
TECHNOLOGY
CORPORATION

2.2.2.3 *Other Actions*

No other actions have been performed at this site.

2.2.3 *Northwest Drainage System (SD-10)*

2.2.3.1 *Site Description and History*

The Northwest Drainage System (SD-10) includes both the old and existing northwest drainage ditches. The old section of SD-10 ran southwest across what is now Base housing. This old section of SD-10, which was used until approximately 1954 (Figure 2-5), is now filled.

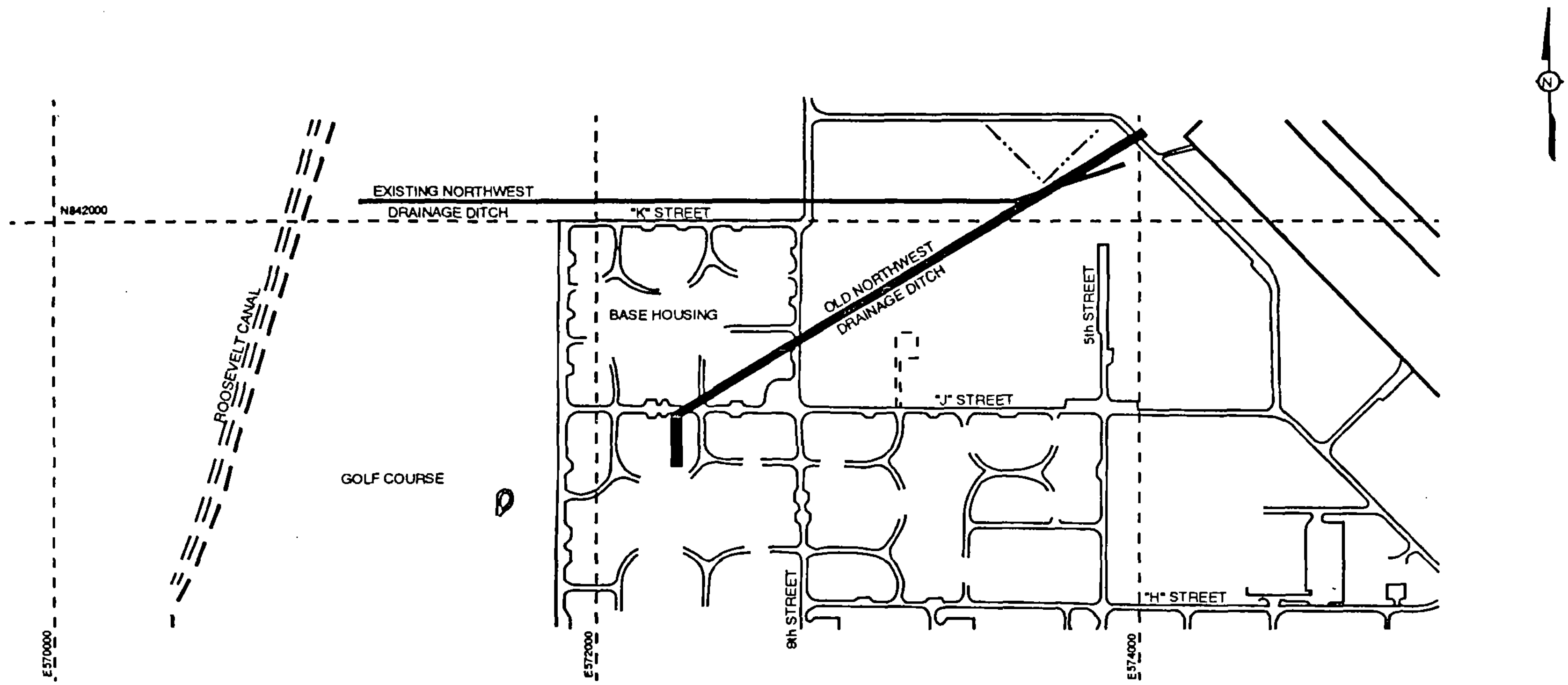
Aerial photographs show that between February 1949 and January 1954, the existing northwest drainage ditch was constructed. This existing portion of SD-10 runs parallel to K Street and Base housing (IT, 1990b) and is located on the northwest corner of the Base. It traverses the northernmost section of the Base within 100 feet of Base housing. It then extends west to the golf course. Its channel is approximately 2,100 feet long, 20 feet wide, and 5 feet below grade.

SD-10 receives drainage from a portion of the flight line and has been in place since 1950. This site was investigated because spills of aircraft washing solution and shop wastes may have washed into SD-10 (ES, 1984).

2.2.3.2 *Investigations*

During the Phase I investigation, ES determined that SD-10 may have been contaminated by past hazardous material handling and disposal practices (ES, 1984). During Phase II, Stage 1 (conducted in 1984), AV drilled four borings (NW-01 through -04) to a maximum depth of 2 feet using a hand auger. During the Stage 2 activities (conducted in 1986), AV drilled an additional nine soil borings (NW-05 through -13) to a maximum depth of 40 feet and collected and analyzed 40 soil samples. As shown in Figure 2-6, these samples were collected in the vicinity of the existing drainage ditch.

As part of the RI, IT installed four shallow boreholes in 1989 (OT-02-55-01 through -04) to a depth of 31 feet and collected and analyzed 12 soil samples. These samples were located at the inlet and outlet of both the existing and the old drainage ditch. IT also collected and analyzed two surface soil samples from the old section of the ditch in February 1989.



LEGEND:

- - BASE BOUNDARY

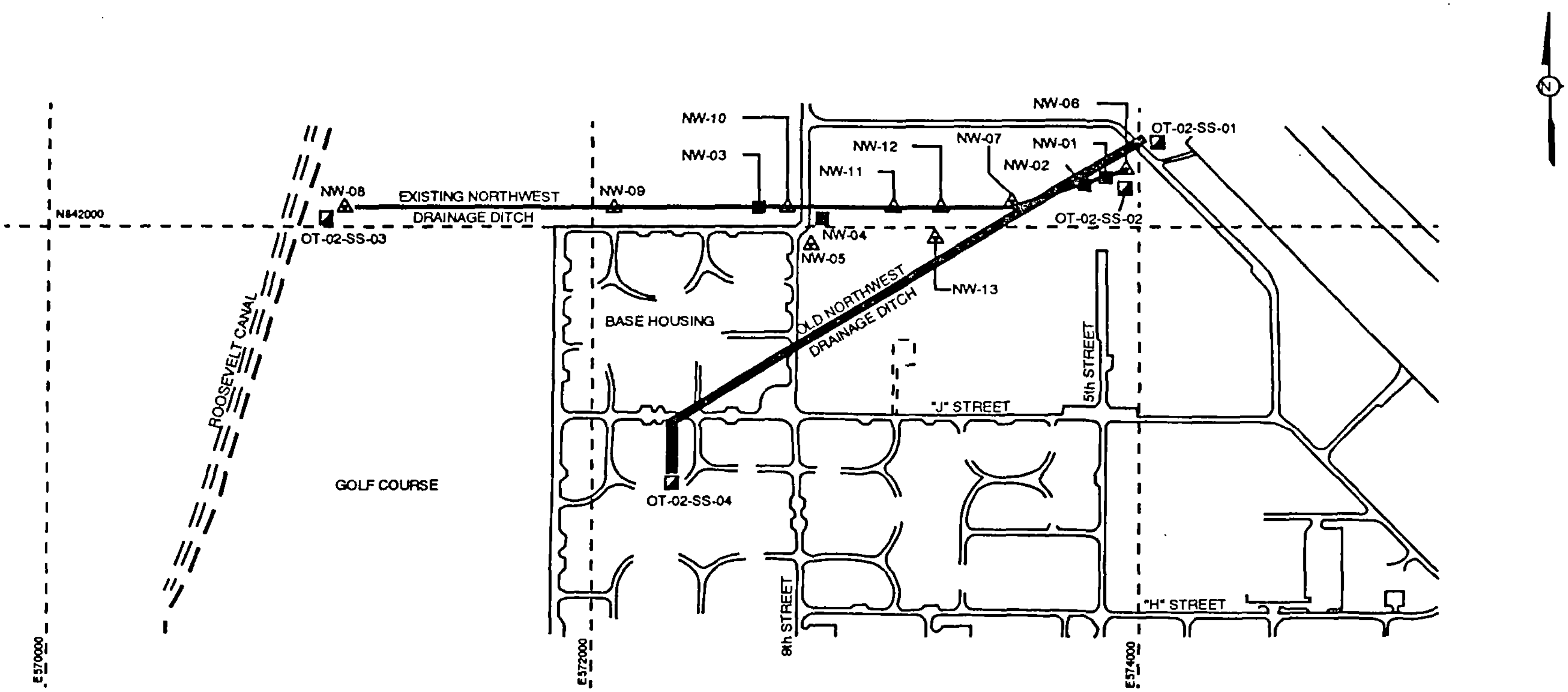
SCALE:

0 400 800 FEET

FIGURE 2-5

WILLIAMS AIR FORCE BASE
NORTHWEST DRAINAGE SYSTEM
(SD-10)

INTERNATIONAL
TECHNOLOGY
CORPORATION



LEGEND:

- IT SOIL BORING LOCATION (APPROXIMATE) AND NUMBER
- AV STAGE 1 SOIL BORING LOCATION (APPROXIMATE) AND NUMBER
- AV STAGE 2 SOIL BORING LOCATION (APPROXIMATE) AND NUMBER
- BASE BOUNDARY

NOTE:
IT AND AV SOIL BORINGS ARE SHALLOW

SCALE: 0 400 800 FEET

FIGURE 2-6

WILLIAMS AIR FORCE BASE NORTHWEST DRAINAGE SYSTEM (SD-10) SOIL BORING LOCATIONS

INTERNATIONAL TECHNOLOGY CORPORATION

In September 1993, five surface soil samples were collected and analyzed for metals to confirm the presence or absence of contaminants at the surface soil level.

2.2.3.3 Other Actions

No additional action has been taken at this site.

2.2.4 Radioactive Instrumentation Burial Area (RW-11)

2.2.4.1 Site Description and History

The Radioactive Instrumentation Burial Area (RW-11) covers approximately 100 square feet and is located near the southern edge of the Base just east of LF-04 (Figure 2-7). RW-11 is located approximately 2,000 feet south and 1,800 feet east of the Base housing. The area was fenced with warning signs attached to the fence identifying the area as a radioactive materials burial area (IT, 1991d) until the removal action in December 1992. After clean closure, the fence and signs were removed.

It had been common practice until approximately 1958 for the USAF to bury dials painted with radium-luminous paint, electron tubes containing radium-bearing parts, and possibly other contaminated instruments or equipment. These instruments, which have low-level radioactive content, are believed to have been buried in this area before 1960 (ES, 1984).

Radioactive instruments were reportedly placed in a drilled hole and then the holes were filled with cement. There were five areas at RW-11 with buried concrete cylinders approximately 1 foot in diameter where items are suspected of being buried. No information was available in the files or through interviews to confirm waste type and quantity, years wastes were buried, or burial procedures or configurations (ES, 1984).

2.2.4.2 Investigations

During the Phase I investigation, ES identified RW-11 at Williams AFB as an area where past disposal practices may have resulted in contamination. The radioactivity count at the surface was reported as normal in 1984 (ES, 1984). Nine soil samples from 30-foot borings next to three of the five cylindrical buried concrete footings were collected and analyzed by AV in 1986 (Phase II, Stage 2). These soil samples did not show levels of radioactivity significantly above site-specific background levels.

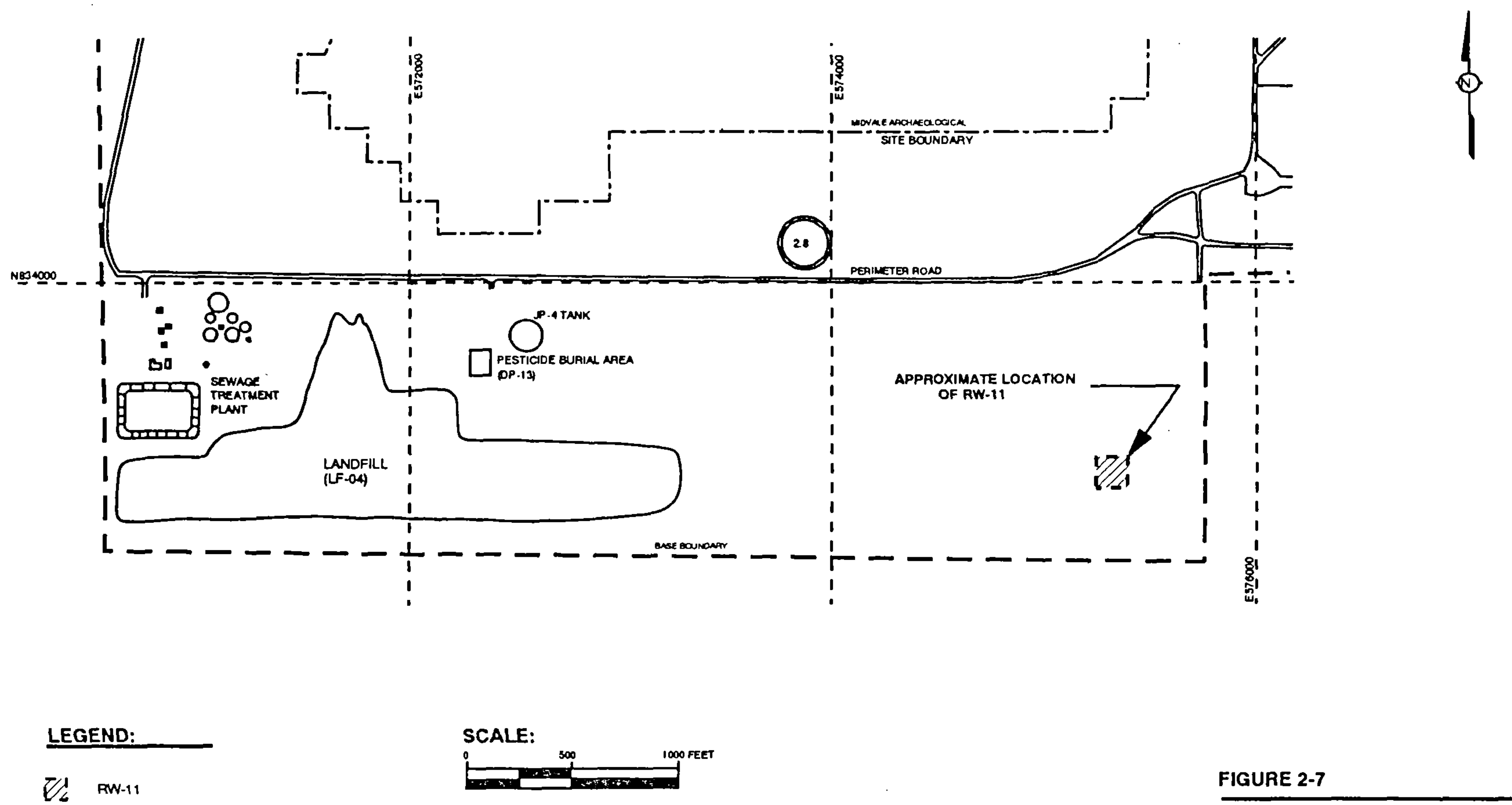


FIGURE 2-7

WILLIAMS AIR FORCE BASE
RADIOACTIVE INSTRUMENTATION
BURIAL AREA (RW-11)

INTERNATIONAL
TECHNOLOGY
CORPORATION

In 1989, as part of the RI, IT installed two shallow boreholes beside the two remaining buried concrete footings. Six soil samples were collected from the boreholes and a radiological analysis was performed. A third boring was also installed 200 feet north of RW-11 and 700 feet south of Perimeter Road to collect site-specific background data.

In December 1992, subsequent to the removal of five buried concrete footings, IT obtained samples from the sidewalls of each of the pits associated with the footings. The samples were taken at 3, 6, and 9 feet in depth for a total of 15 samples. In addition, a site-specific background sample was collected approximately 200 feet south of RW-11 at a depth of 1 foot. Sample locations are shown in Figure 2-8.

2.2.4.3 Other Actions

An Engineering Evaluation/Cost Analysis (EE/CA) was completed for this site in 1991 (IT, 1991d). In accordance with that EE/CA and under the authority of the USAF Radioisotope Committee, a removal action at this site was completed in December 1992. A draft Removal Report was issued in June 1993 (IT, 1993a).

2.2.5 Pesticide Burial Area (DP-13)

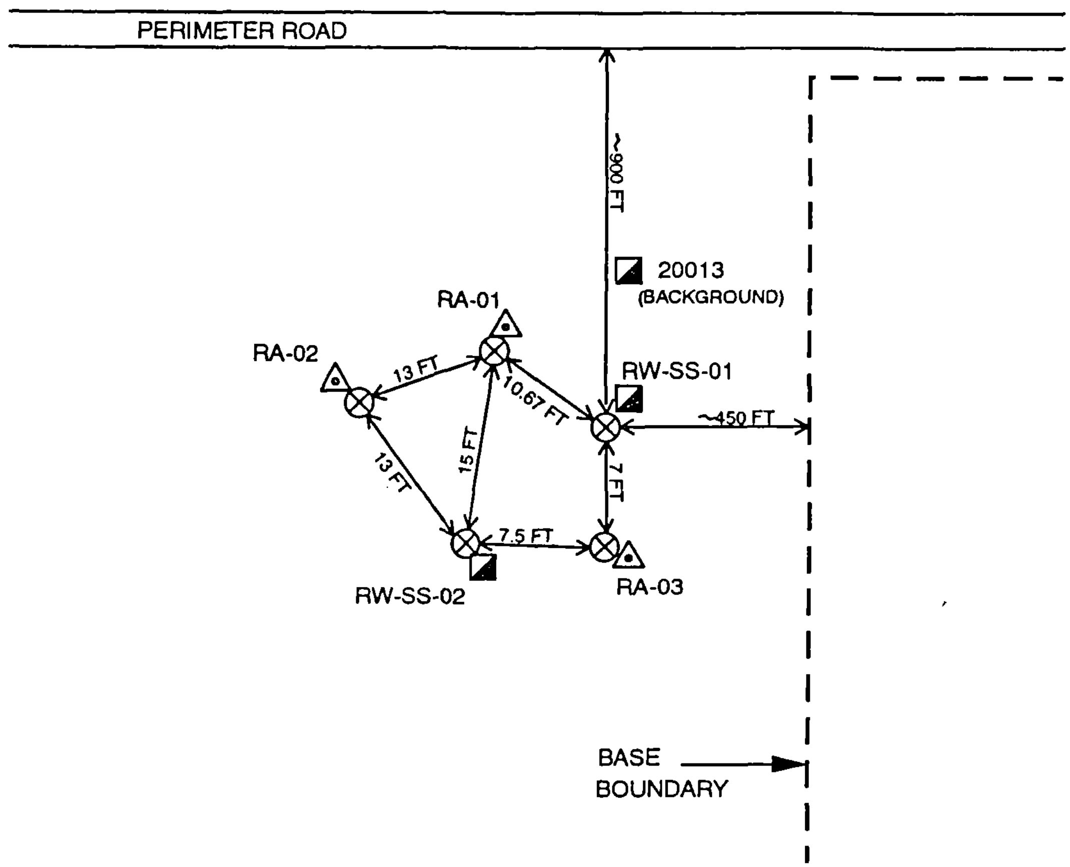
2.2.5.1 Site Description and History

The Pesticide Burial Area (DP-13) is located immediately northeast of LF-04 in the southwest corner of the Base (Figure 2-9). The site is less than 0.4 acre and is located approximately 1,500 feet south of Base housing.

Between 1968 and 1972, drums containing unused or outdated pesticides were buried at this site on four or five occasions and signs were erected marking the general location. The types and quantities of pesticides buried at DP-13 were not documented (ES, 1984).

2.2.5.2 Investigations

The Phase I document identified DP-13 as a site at Williams AFB where past disposal practices may have resulted in contamination. A magnetometer survey was conducted by AV in 1984 and 1985 (Phase II, Stage 1) to locate the buried drums. This survey identified ten potential burial locations, all at depths of approximately 5 feet. No sampling or drilling activities were conducted at this time.



LEGEND:

- IT SOIL BORING LOCATION (APPROXIMATE) AND NUMBER
- AV STAGE 2 SOIL BORING LOCATION (APPROXIMATE) AND NUMBER
- CONCRETE FOOTING

NOTES:

1. DISTANCES TO LANDMARKS NOT TO SCALE
2. IT AND AV SOIL BORINGS ARE SHALLOW

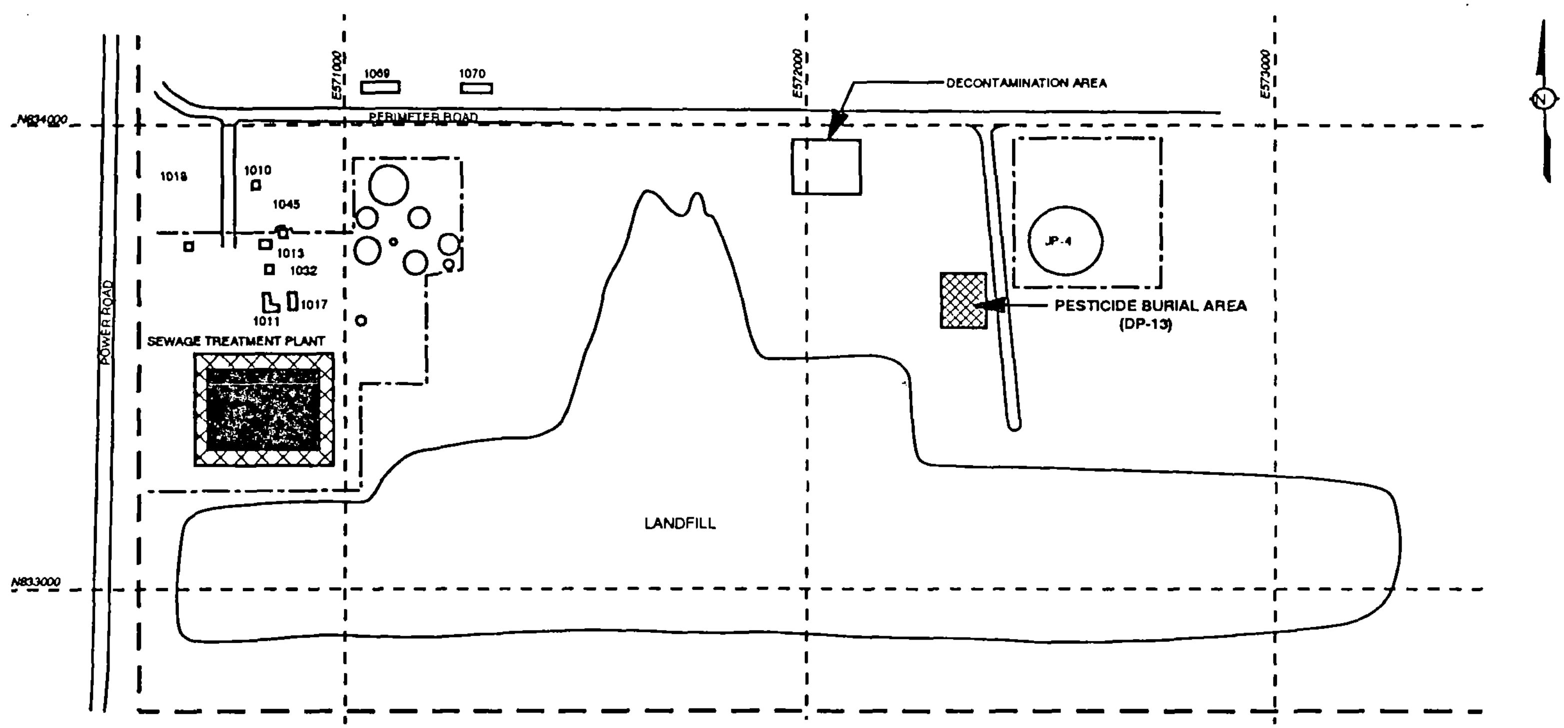
NOT TO SCALE

FIGURE 2-8

WILLIAMS AIR FORCE BASE RADIOACTIVE INSTRUMENTATION BURIAL AREA (RW-11) SOIL BORING LOCATIONS

INTERNATIONAL TECHNOLOGY CORPORATION

RW11SB DRW/SAL/2-92



LEGEND:

BASE BOUNDARY

SCALE:

0 250 500 FEET

FIGURE 2-9

WILLIAMS AIR FORCE BASE PESTICIDE BURIAL AREA (DP-13)

INTERNATIONAL TECHNOLOGY CORPORATION

During the 1987 (Phase II, Stage 2) investigation by AV, eight shallow soil borings were drilled near the magnetic anomalies that were identified by the magnetometer survey. One of these boreholes was drilled to a depth of 50 feet while the remaining seven were drilled to a maximum depth of 20 feet. Two soil borings were also drilled outside DP-13 to establish site-specific background and geotechnical conditions. AV collected and analyzed 36 soil samples during the Phase II, Stage 2 investigation.

IT completed a second magnetometer survey in November 1988 as part of the RI. This survey confirmed all of the previous magnetic anomalies found within the fenced boundaries of DP-13, except one located at the eastern edge of the area that did not appear to be caused by buried drums. Three additional anomalies were discovered outside the fence during the 1988 survey (IT, 1990c). Locations and discussion of the anomalies are provided in Section 2.6 of the OU-1 RI.

During the RI by IT in 1989, two soil borings (WP-B-01 and WP-B-02) were drilled and seven soil samples were collected and analyzed. IT also collected and analyzed 6 and 12 surface soil samples in 1989 and 1991, respectively. Additional confirmatory soil samples were collected during the removal of the buried drums.

Locations of soil samples are presented in Figure 2-10.

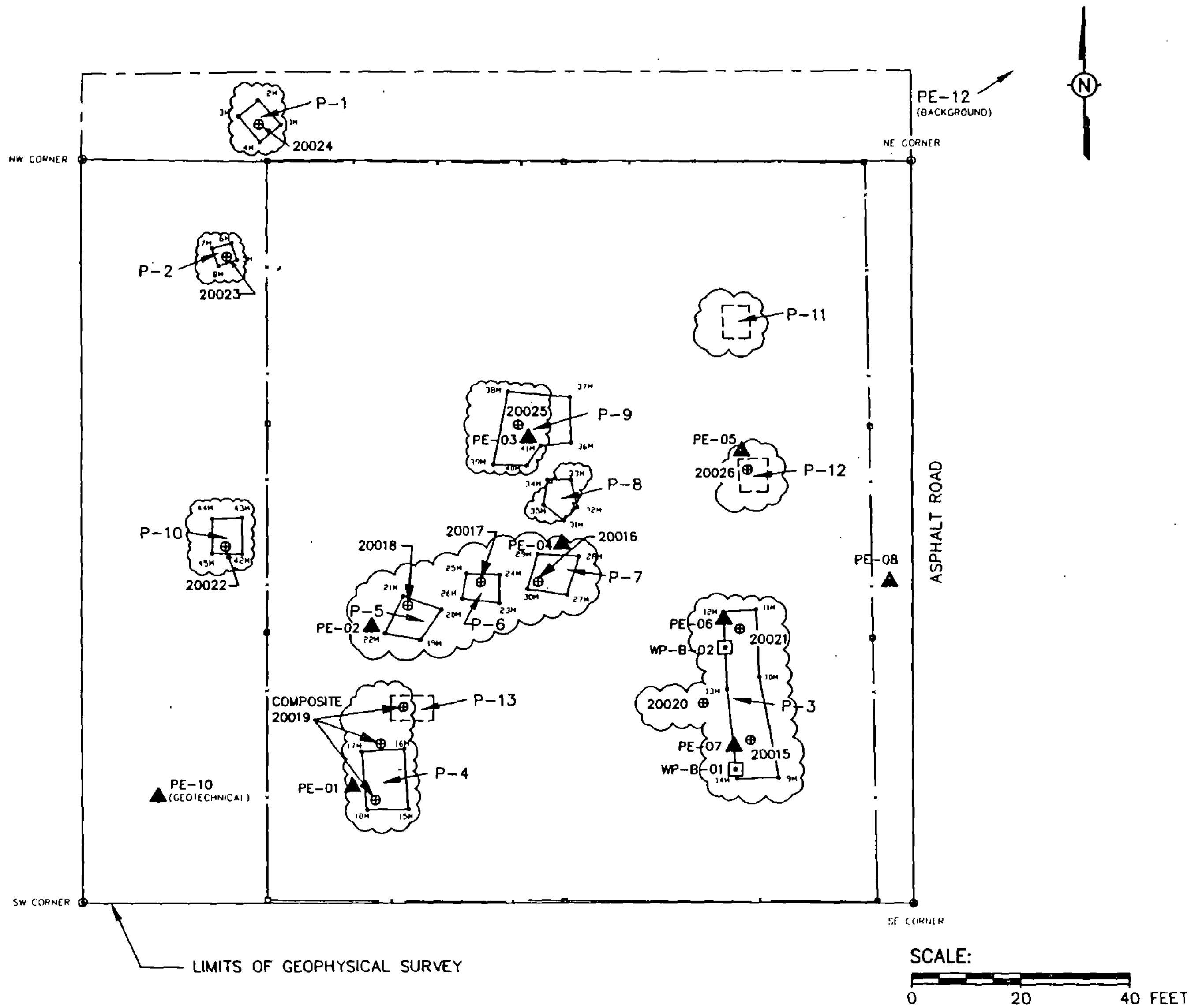
2.2.5.3 Other Actions

An EE/CA was completed for this site in 1990, recommending removal of the buried drums. In May 1991, the buried drums were excavated and removed from DP-13 and properly disposed of by a USAF subcontractor. Following completion of the removal action, the fence was dismantled and the signs removed.

2.2.6 Hazardous Materials Storage Area (SS-01)

2.2.6.1 Site Description and History

The Hazardous Materials Storage Area (SS-01) is located just south of Taxiway No. 6, near Building 1090 (Figure 2-11) and is an unmarked area approximately 30 feet by 40 feet. Paint, solvents, caustics, and other materials used for maintenance operations were stored in this area from 1959 until it was abandoned in 1983. As a result, this area was a suspected location for minor spillage or leakage of hazardous wastes (ES, 1984).



LEGEND:

- ACTUAL NORTH LIMITS OF GEOPHYSICAL SURVEY AREA
- DESIGNATED LIMITS OF GEOPHYSICAL SURVEY AREA
- SW CORNER — CORNER OF DESIGNATED GEOPHYSICAL SURVEY AREA
- P-X — MARKED LOCATION OF PIT, POSSIBLY CONTAINING METALLIC DEBRIS
- UNMARKED PIT LOCATION
- EXCAVATION BOUNDARY (APPROXIMATE)
- FENCE LINE
- 1M — CORNER MARKER OF PIT, STAKED, FLAGGED AND LABELED AS SHOWN
- IT BOREHOLE SAMPLE LOCATION
- PREVIOUS AV BOREHOLES (APPROXIMATE LOCATIONS)
- 20021 — EXCAVATION SOIL SAMPLES TAKEN MAY 7, 8, AND 9, 1991
- FENCE POST

NOTES:

P-10 – NO MAGNETIC ANOMALY BUT THERE IS STAINING

P-2 – SLIGHT MAGNETIC ANOMALY WITH EVIDENCE OF BURIAL.

P-1 – MAGNETIC ANOMALY OUTSIDE SURVEY BOUNDRIES, PIT MARKED

AREA SHOWS MAGNETIC ANOMALIES DETECTED IN 1988 IT SURVEY

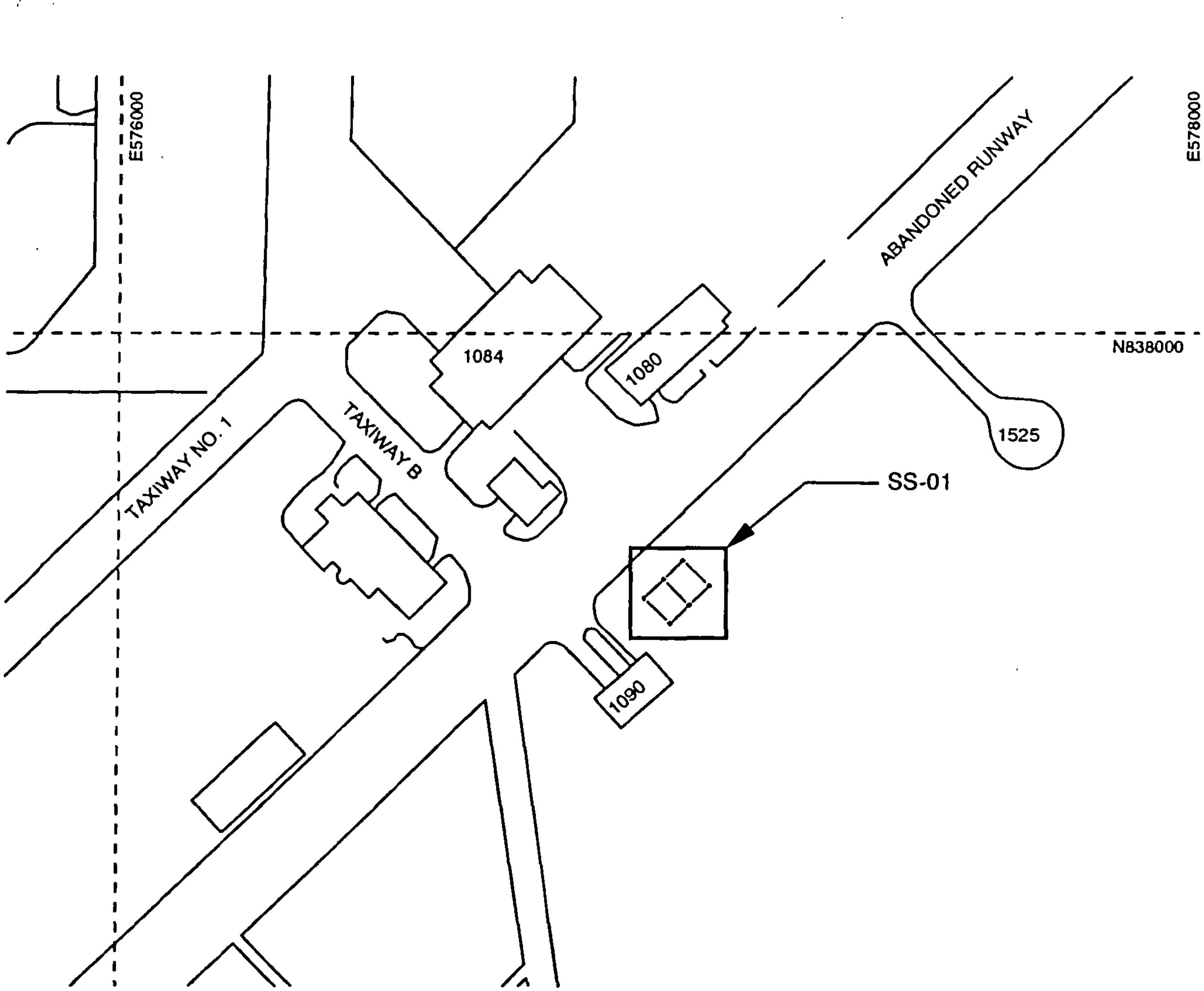
FIGURE 2-10

WILLIAMS AIR FORCE BASE PESTICIDE BURIAL AREA (DP-13) SOIL BORING LOCATIONS

INTERNATIONAL TECHNOLOGY CORPORATION

DRAWING NO. 409735-B-48 | PROJ. NO.: 409735 | INITIATOR R. CLARK | PROJ. MGR.: W. CARTER | DRAFT. CHCK BY G. PACHECO | ENGR. CHCK BY R. CLARK | DATE LAST REV 4/4/94 | DRAWN BY repilts | STARTING DATE: 03/05/92 | DRAWN BY: C. ROBERTSON

40973548 04/13/94 10 38am REP



LEGEND:

1080 FACILITY NUMBER

SCALE:

0 325 650 FEET

FIGURE 2-11

WILLIAMS AIR FORCE BASE HAZARDOUS MATERIALS STORAGE AREA (SS-01)

INTERNATIONAL TECHNOLOGY CORPORATION

1HMSA.DRW/SAL/1-92

2.2.6.2 Investigations

The Phase I document identified SS-01 as a site at Williams AFB where past handling and disposal practices may have resulted in contamination. No field work was performed at SS-01 during the Phase II, Stage 1 activity. During the Stage 2 activity, AV drilled 12 soil borings and collected and analyzed 42 soil samples (AV, 1987). In 1991, during the RI performed by IT, four deep boreholes were drilled, from which 16 soil samples were collected and analyzed.

Locations of borings are presented in Figure 2-12.

2.2.6.3 Other Actions

No other actions have been performed at this site.

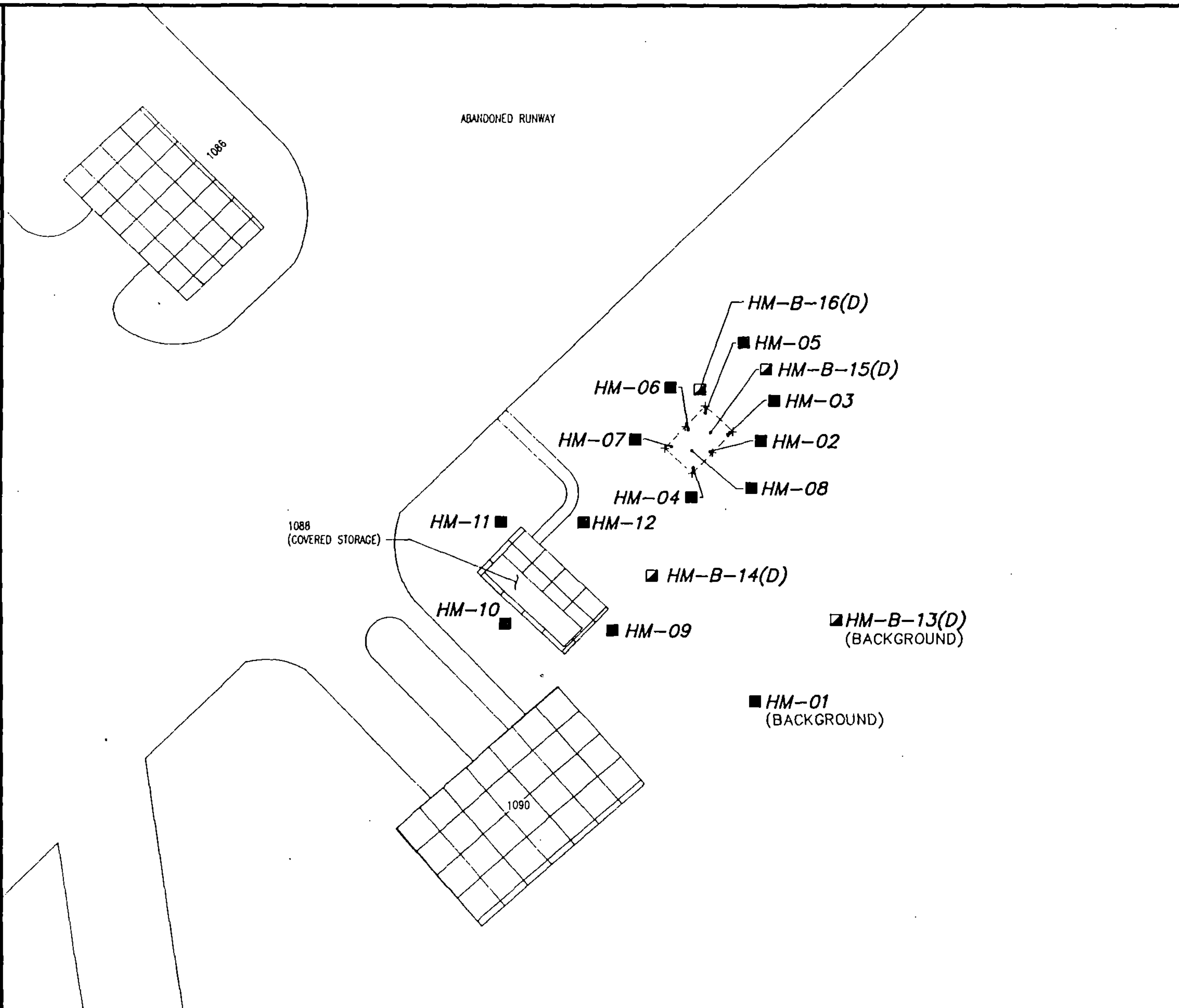
2.2.7 USTs at Building 789 (ST-05)

2.2.7.1 Site Description and History

During the history of the Base, USTs have been used to store diesel, gasoline, waste oil, and other materials. Five of these tanks were located at the former Base Motor Pool. The former Motor Pool was located at the current cable television area approximately 1,000 feet west of 5th Street and just south of A Street. The tanks at Building 789 were assigned a current site designation of ST-05.

ST-05 included four 12,000-gallon and one 1,000-gallon USTs. The four 12,000-gallon tanks were used to store gasoline and diesel for the motor pool. The tanks were installed side-by-side in an east-west line approximately 90 feet south of A Street between Building 789 in the television satellite dish area and the Base impound yard (Facility 782). The tanks are numbered LU-01-1, LU-01-2, LU-01-3, and LU-01-4 from west to east. The 1,000-gallon tank, designated LU-01-05 and located just north of LU-01-4, was a waste oil tank that was connected to a sump in the concrete slab at the motor pool. The locations of these abandoned tanks are shown in Figure 2-13.

These USTs were installed in 1941 and abandoned in the early 1950s. All of these tanks were constructed of carbon steel and their exteriors were tar-coated.



LEGEND:

◪	IT SOIL BORING LOCATION (APPROXIMATE) AND NUMBER
■	AV SOIL BORING LOCATION (APPROXIMATE) AND NUMBER
(D)	DENOTES DEEP BORING
1088	FACILITY NUMBER
⌜ ⌝	HAZARDOUS MATERIALS STORAGE AREA

SCALE:

0 60 120 FEET

FIGURE 2-12

WILLIAMS AIR FORCE BASE
HAZARDOUS MATERIALS STORAGE AREA (SS-01)
SOIL BORING LOCATIONS

INTERNATIONAL TECHNOLOGY CORPORATION

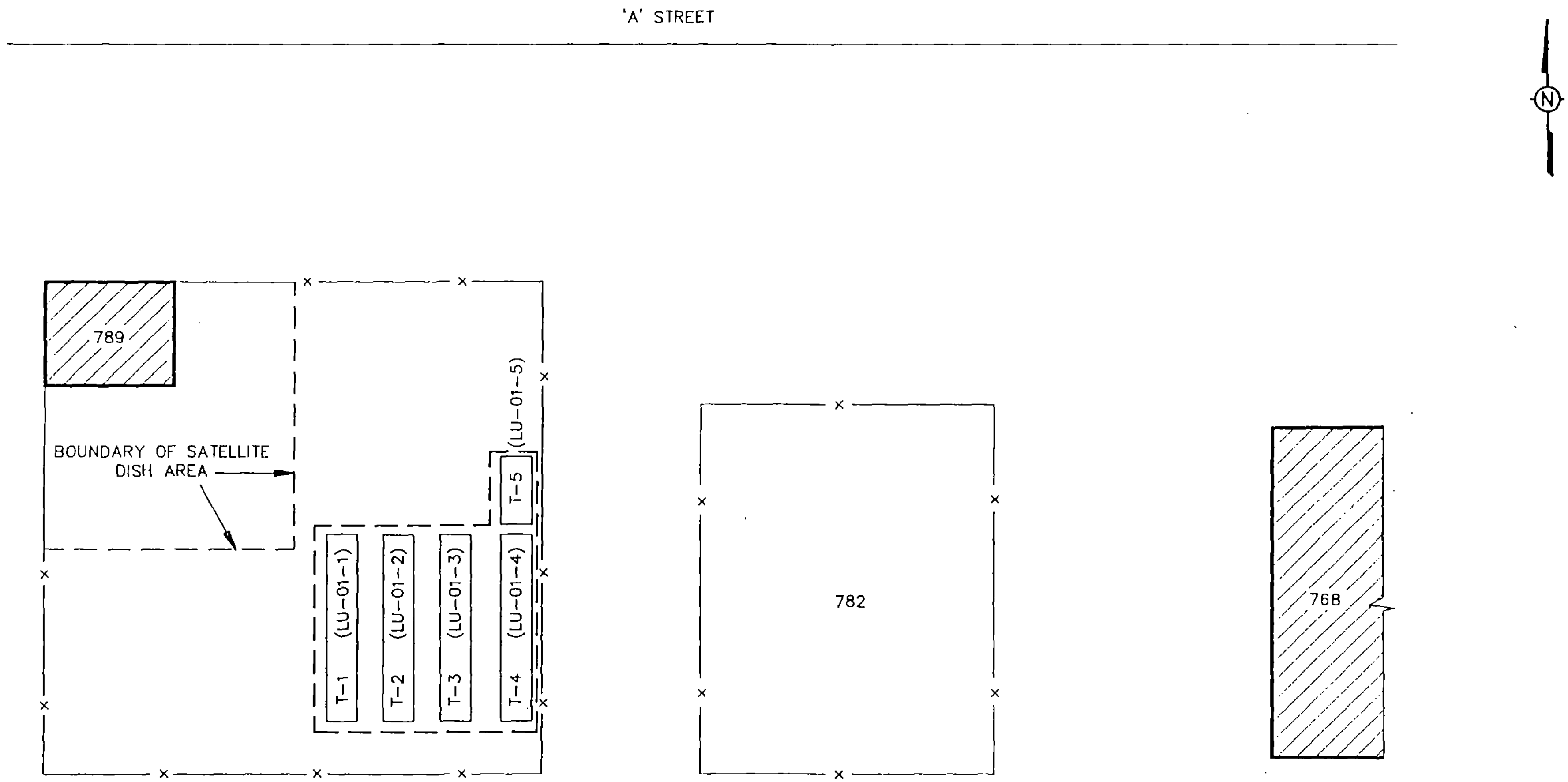
STARTING DATE: 8/30/93 | DATE LAST REV.: 12/9/93 | DRAFT. CHCK. BY: R. PITTS | INITIATOR: W. ANDERSON | DWG. NO.: 409735-B-114

DRAWN BY: S. CARDWELL | DRAWN BY: J. TABLER | ENGR. CHCK. BY: W. ANDERSON | PROJ. MGR.: W. CARTER | PROJ. NO.: 409735

1

409735 OU1 ROD

97350114 08/30/93 4:03pm STC



LEGEND:

—×—	FENCE LINE
(hatched box)	BUILDING
789	STRUCTURE/FACILITY NUMBER
T-X	APPROXIMATE LOCATION OF ABANDONED TANKS
— — —	LIMIT OF TANK EXCAVATION

SCALE:
0 20 40 FEET

FIGURE 2-13
WILLIAMS AIR FORCE BASE
UNDERGROUND STORAGE
TANKS (ST-05)
LOCATION OF ABANDONED TANKS

INTERNATIONAL TECHNOLOGY CORPORATION

DRAWING NO.: 409735-B-115 | PROJ. NO.: 409735 | INITIATOR: W. ANDERSON | PROJ. MGR.: W. CARTER | DRAFT. CHCK. BY: G. PACHECO | ENGR. CHCK BY: W. ANDERSON | DATE LAST REV.: 12/9/93 | DRAWN BY: J. TABLER | STARTING DATE: 8/31/93 | DRAWN BY: J. TABLER

409735 OU1-ROD
97350115 12/09/93 9:22am JAT

2.2.7.2 Investigations

These tanks were not identified in 1984 during the Phase I investigation as being an area where past handling and disposal practices may have resulted in contamination, nor were they included in the scope of AV's investigations. As a result, no work was done at ST-05 during Phase I or Phase II investigations. Their possible locations were determined from Base maps. As part of the RI, IT conducted a magnetometer survey of the area in 1988 to verify the existence and locations of these tanks.

2.2.7.3 Other Actions

In 1990, during the RI, a USAF contractor, Exceltech, completed removal of these tanks. IT performed oversight of the removal, collected duplicates of selected soil samples, and analyzed the results for independent verification.

Exceltech first sampled the tank contents during November 1990. Analytical results were used to determine the appropriate disposal technique for those contents and to identify constituents to analyze for in the soil samples underneath the tanks. Next, the tanks were emptied of all liquids and tank sludge. The tanks were then excavated and inspected for staining, cracks, or holes to determine if leakage had occurred.

Soil sampling at the UST excavations was conducted during the removal in December 1990. Samples were collected from the bottom and sides of the excavations. A sample was also collected from the stockpiled soil from the excavation, and a site-specific background sample was collected from the east side of Building 789. Sample locations are shown in Figure 2-14.

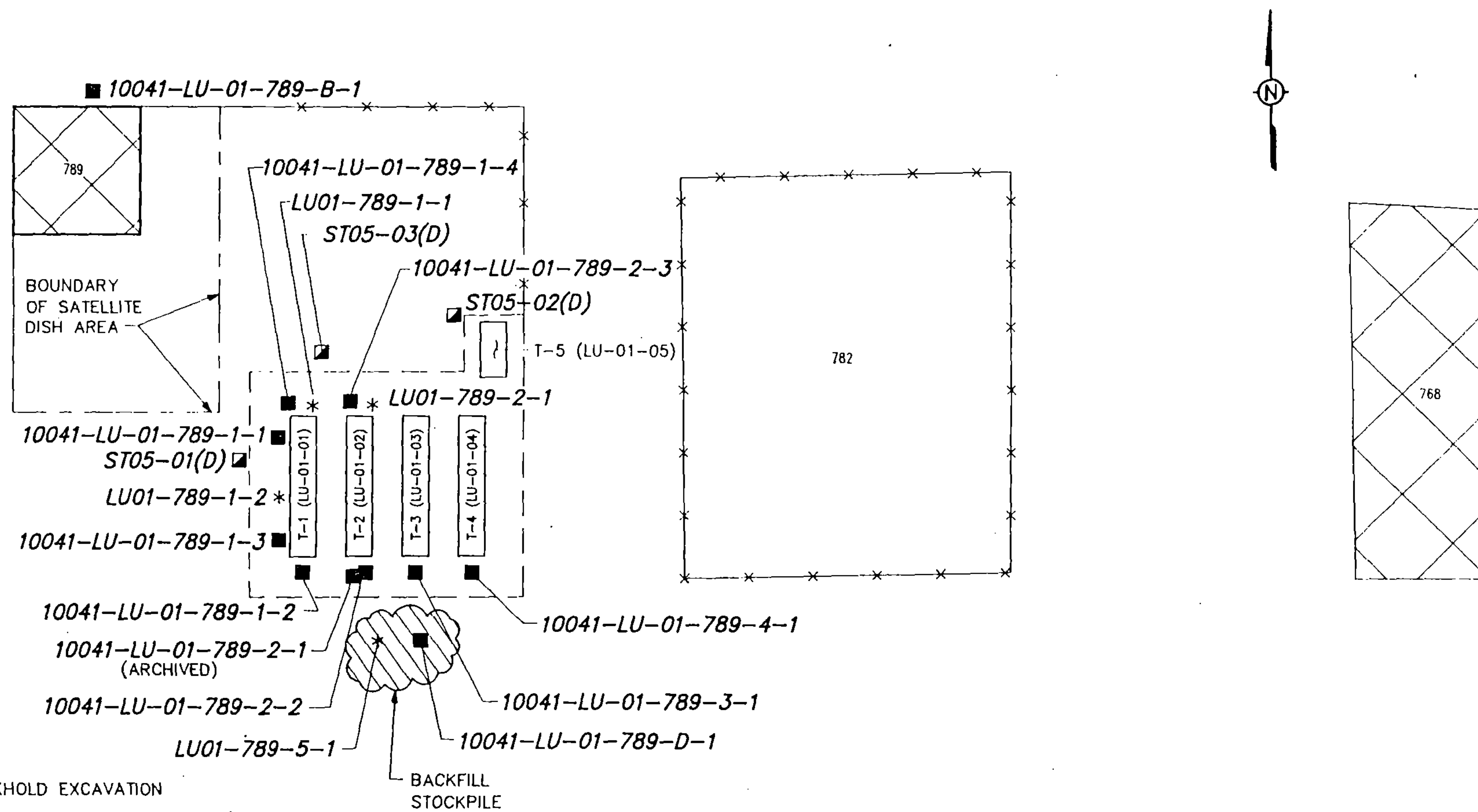
The tanks were removed and disposed of and the excavations were backfilled with uncontaminated soil. The excavated contaminated soil was disposed of at the Butterfield Station Landfill in Mobile, Arizona. In September 1991, IT installed three boreholes from which 12 additional samples were taken and analyzed to verify if constituents were still present.

2.2.8 USTs at Building 725 (ST-06)

2.2.8.1 Site Description and History

The USTs at Building 725 (ST-06) were located at the old Higley gas station, just west of Building 725. The old Higley gas station was located on the southwest corner of B and 11th streets. There were two abandoned USTs at this location.

DWG. NO.: 409735-B-116
PROJ. NO.: 40973561
INITIATOR: W. ANDERSON
PROJ. MGR.: W. CARTER
DRAFT. CHCK. BY: R. PITTS
ENGR. CHCK. BY: W. ANDERSON
DATE LAST REV.: 12/9/93
DRAWN BY: J. TABLER
STARTING DATE: 8/31/93
DRAWN BY: J. TABLER
1
409735 OU1-ROD
97350116 08/31/93 10:57am JAT



NOTES:

—×—	FENCE LINE
— — —	LIMITS OF TANKHOLD EXCAVATION
◪	IT SOIL BORING LOCATION (APPROXIMATE) AND NUMBER
(D)	DENOTES DEEP BORING
768	STRUCTURE/FACILITY NUMBER
T-X	APPROXIMATE LOCATION OF ABANDONED TANKS BEFORE REMOVAL
*	IT SOIL SAMPLE LOCATION (APPROXIMATE)
■	EXCELTECH SOIL SAMPLE LOCATION (APPROXIMATE)

SCALE:
0 20 40 FEET

FIGURE 2-14
WILLIAMS AIR FORCE BASE
FORMER MOTOR POOL BUILDING
BUILDING 789 (ST-05)
SOIL BORING/SOIL SAMPLE
LOCATIONS

IT INTERNATIONAL TECHNOLOGY CORPORATION

A 12,000-gallon tank designated LU-02-716 was used to store gasoline and a 1,000-gallon tank, LU-02-730, was believed to have contained waste oil. Both were installed before 1938 and were abandoned around 1954. Tank No. LU-02-716 was located west of Building 716 and Tank No. LU-02-730 was located southwest of Building 730. These structures have either been demolished or removed. The tanks were constructed of carbon steel and the exteriors were coated with tar. The locations of these abandoned tanks are shown in Figure 2-15.

2.2.8.2 Investigations

These tanks were not identified in 1984 during the Phase I investigation as being an area where past handling and disposal practices may have resulted in contamination. Furthermore, they were not included in the scope of AV's investigations; therefore, no work was performed at ST-06 during Phase I or Phase II investigations. IT conducted a magnometer survey of the area in 1988 to verify the existence and locations of these tanks.

2.2.8.3 Other Actions

During the RI, Exceltech completed a removal action of these tanks. IT performed oversight activities, collected duplicates of selected soil samples, and analyzed the results for independent verification.

During November 1990, Exceltech sampled the tanks in which residual liquids were present and emptied the tanks of all liquids and tank sludge. The tanks were then excavated and inspected for staining, cracks, or holes to determine if leakage had occurred.

Soil sampling at the UST excavations was conducted in December 1990. Samples were collected from the bottom and sides of the excavation. The tanks were removed and disposed of and the excavations were backfilled with clean material. In 1990, the excavated contaminated soil was disposed of at the Butterfield Station Landfill, Mobile, Arizona. In September 1991, IT installed three boreholes from which 12 samples were collected and analyzed. The locations of the borings are also shown in Figure 2-16. Samples were collected at locations near the tankhold which is not immediately adjacent to Building 725. Borings were not installed at the former Building 725 site because there was no suspected contamination at this site.

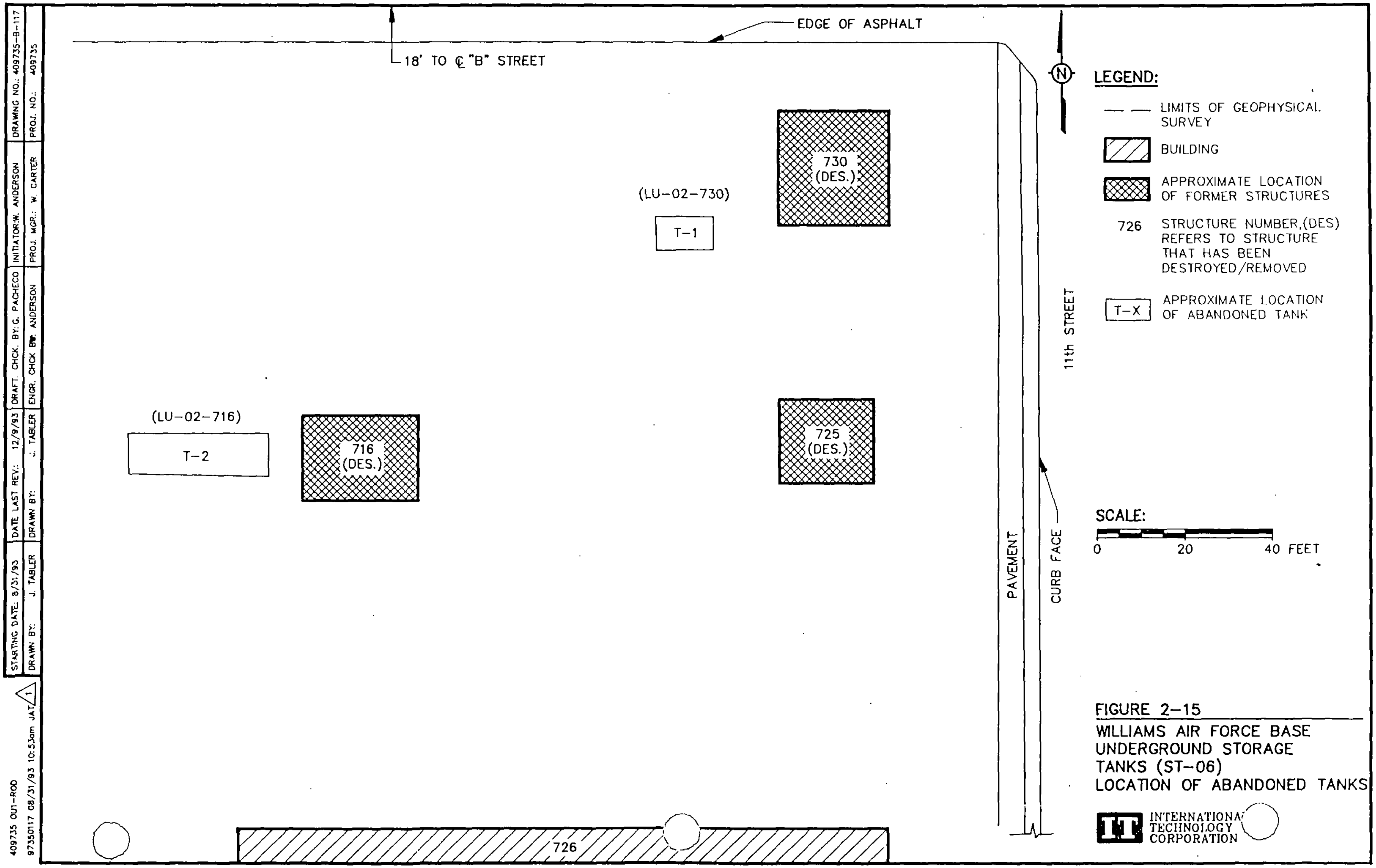
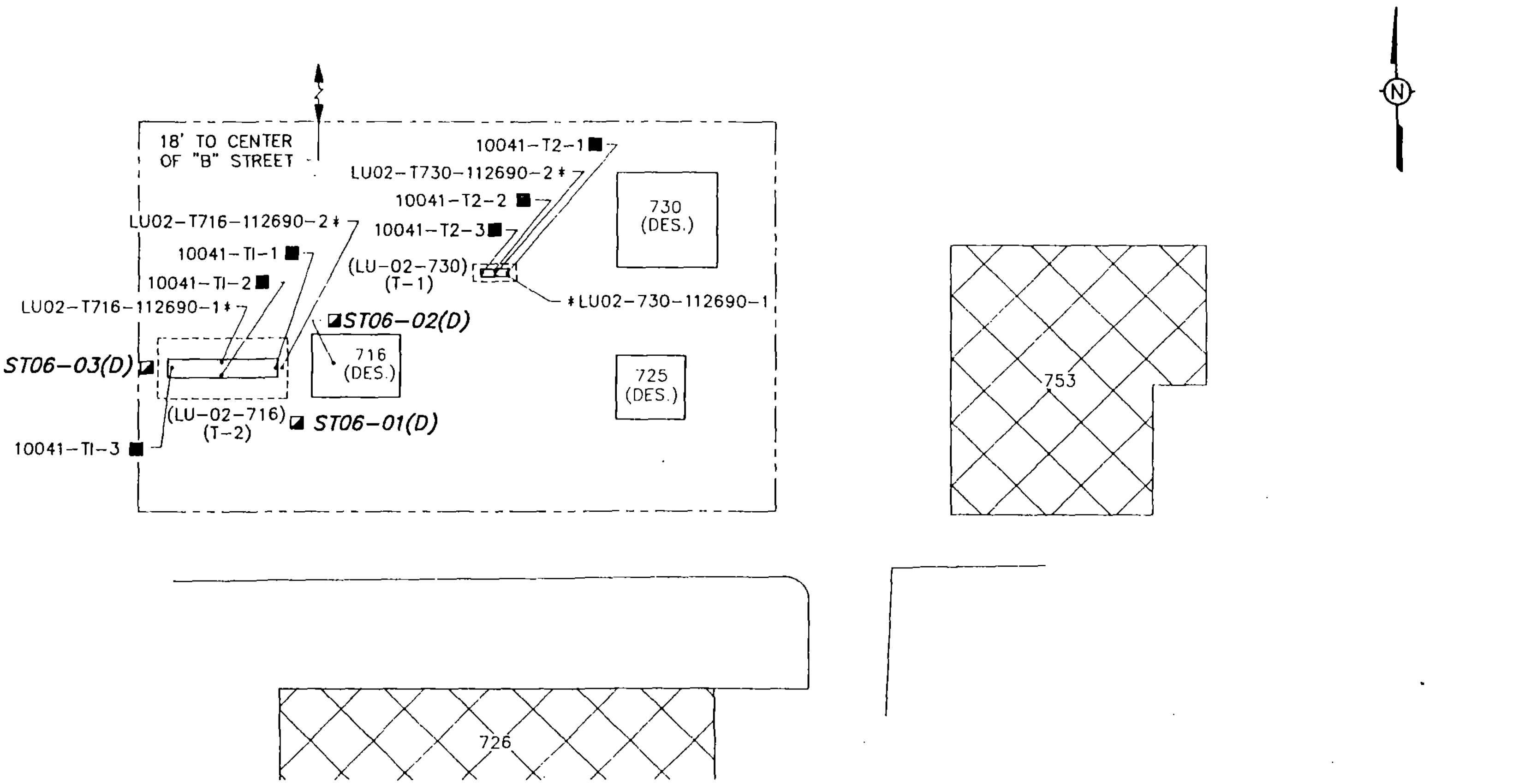


FIGURE 2-15
WILLIAMS AIR FORCE BASE
UNDERGROUND STORAGE
TANKS (ST-06)
LOCATION OF ABANDONED TANKS



LEGEND:

753 (DES.)	STRUCTURE/FACILITY NUMBER (DESTROYED)
◪	IT SOIL BORING LOCATION (APPROXIMATE) AND NUMBER
— - — -	LIMITS OF GEOPHYSICAL SURVEY
(T-1)	APPROXIMATE LOCATION OF TANKHOLD BEFORE REMOVAL
- - - - -	APPROXIMATE LOCATION OF TANKHOLD EXCAVATION
*	IT SOIL SAMPLE LOCATION (APPROXIMATE)
■	EXCELTECH SOIL SAMPLE LOCATION (APPROXIMATE)

SCALE: 0 40 80 FEET

FIGURE 2-16
WILLIAMS AIR FORCE BASE
FORMER GAS STATION
BUILDING 725 (ST-06)
SOIL BORING/SOIL SAMPLE LOCATIONS

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 8/31/93 | DATE LAST REV.: 12/9/93 | DRAFT. CHCK. BY: R. PITTS | INITIATOR: W. ANDERSON | DWG. NO.: 409735-B-118
DRAWN BY: S. CARDWELL | DRAWN BY: J. TABLER | ENGR. CHCK. BY: W. ANDERSON | PROJ. MGR.: W. CARTER | PROJ. NO.: 409735

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2.2.9 USTs at Building 1086 (ST-07)

2.2.9.1 Site Description and History

USTs located at the southeast corner of Building 1086 at the intersection of Taxiway B and Taxiway No. 6 were designated ST-07. Their past locations are shown in Figure 2-17.

ST-07 consisted of two tanks, one of which had an interior wall dividing it into two compartments. Chambers 1 and 2 compose one tank and Chamber 3 composes the other. Both tanks were constructed of precast concrete halves joined at the centerline and sealed with a rubber (or similar material) gasket. Each tank had a volume of approximately 5,000 gallons. These tanks received wastes from the paint stripping shop (IT, 1992a).

The two sides of the double tank were connected by a pipe located near the top of the dividing wall. The second tank was connected to the double tank by a pipe located near the top of the tanks. There were no outlets from these tanks.

2.2.9.2 Investigations

These tanks were not identified by ES as being an area where past handling and disposal practices may have resulted in contamination. Furthermore, ST-07 was not included in the scope of AV's investigations; therefore, no work was performed at ST-07 during the Phase I or Phase II investigations.

In 1987, Tracer Research Corporation conducted an investigation that indicated the tanks at ST-07 were leaking. As a result, Williams AFB immediately removed the tanks from service and initiated a contract to remove all hazardous material from the tanks and to cap the line entering the tanks.

2.2.9.3 Other Actions

Because these tanks were governed by the Resource Conservation and Recovery Act (RCRA), a RCRA Partial Closure Report (IT, 1992a) was written and approved for removal of these tanks. Exceltech conducted the field activities for removal of these tanks. Oversight of these activities was performed by IT. Exceltech sampled the tanks for characterization of constituents. Analytical results were used to decide the appropriate disposal technique for the materials and to identify constituents for analysis in additional soil samples. Next, the tanks were emptied, excavated, and inspected for potential leakage. Soil samples were collected

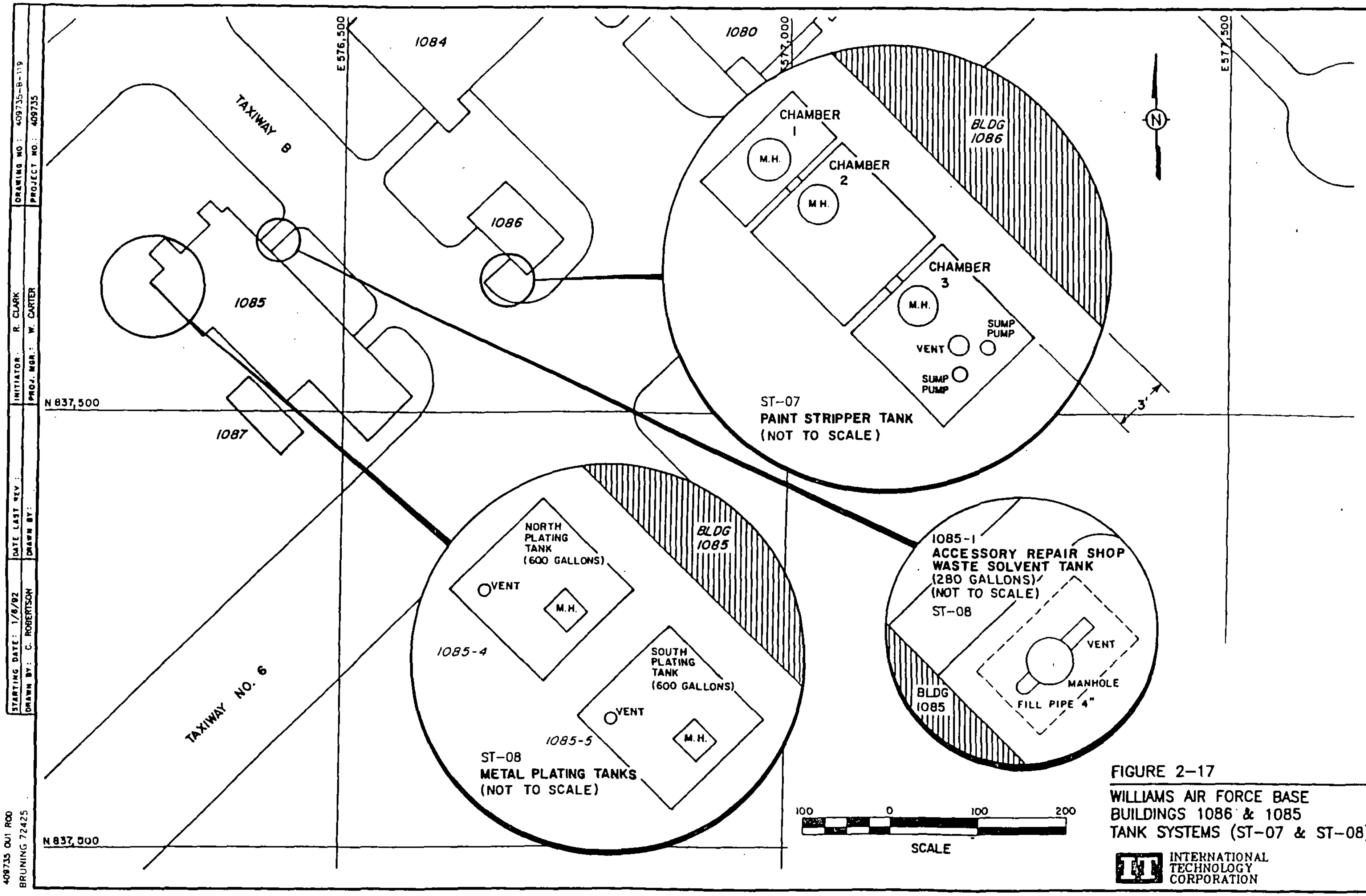

FIGURE 2-17

WILLIAMS AIR FORCE BASE
BUILDINGS 1086 & 1085
TANK SYSTEMS (ST-07 & ST-08)

INTERNATIONAL TECHNOLOGY CORPORATION

from the excavation by both Exceltech and IT to identify any tank leakage and to characterize the constituents of any contamination present.

In 1987, these tanks were removed and the excavated contaminated soil was sent to a permitted landfill for disposal. This action was documented in a RCRA Partial Closure Report (IT, 1992a). During December 1990, three soil samples were collected from the ST-07 tank excavation at the center, west, and east sides at a depth of 13 feet. The samples were analyzed for total petroleum hydrocarbons (TPH), volatile organic compounds (VOC), SVOC, cyanide, anion, and Toxicity Characteristic Leaching Procedure (TCLP) metals. The excavated contaminated soil was shipped to the Butterfield Station Landfill for disposal. In September 1991, IT installed a 40-foot borehole northeast and adjacent to the former tank. Soil samples were analyzed for VOCs, TPH, and TCLP metals. Because there were detectable levels of possible contaminants, this area was moved to the OU-1 for final action.

Soil sample and boring locations are shown in Figures 2-18 and 2-19, respectively.

2.2.10 USTs at Building 1085 (ST-08)

2.2.10.1 Site Description and History

Three USTs (1085-1, 1085-4, and 1085-5) were also located at Building 1085 (ST-08). As shown in Figure 2-17, Tank No. 1085-1 was located on the northeast side of the building; Tanks No. 1085-4 and 1085-5 were located at the northwest corner of the building.

Tank No. 1085-1 consisted of a 280-gallon carbon steel tank mounted on a concrete saddle. This tank received wastes consisting of used cutting oil and solvents from an accessory repair shop (IT, 1992a).

Tanks No. 1085-4 and 1085-5 were 600-gallon precast concrete tanks that received wastes from a metal plating shop. The tanks were connected by a pipe located near the top of the vessels. An outlet from the tanks, located near the top of the northwest corner of Tank No. 1085-5, drained to the west.

2.2.10.2 Investigations

These tanks were not identified by ES as being an area where past handling and disposal practices may have resulted in contamination. Furthermore, they were not included in the

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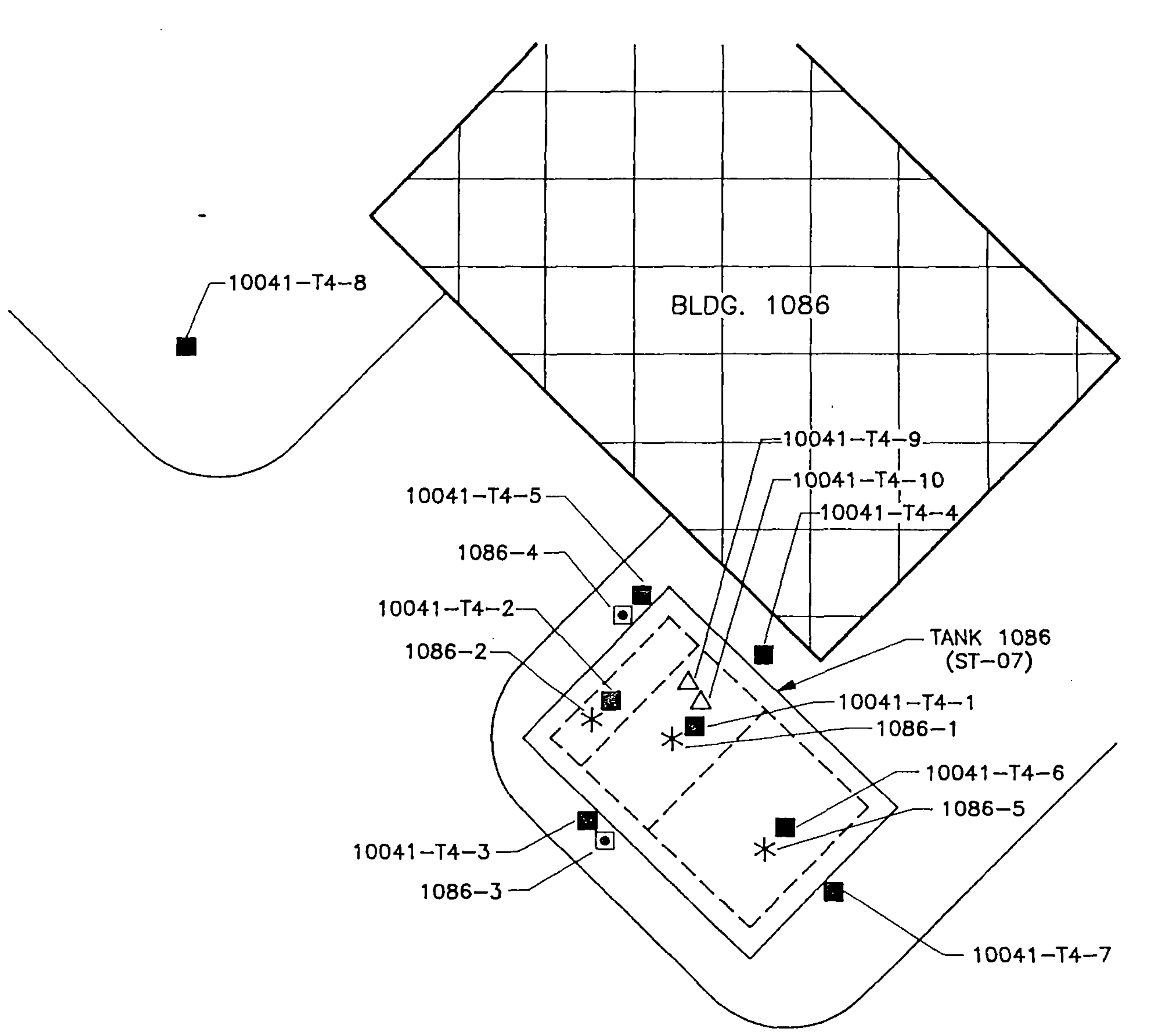
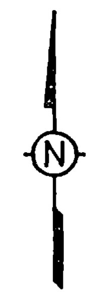
STARTING DATE: 8/31/93	DATE LAST REV.: 12/9/93	DRAFT. CHCK. BY: R. PITTS	INITIATOR: W. ANDERSON	DWG. NO.: 409735-A-120
DRAWN BY: J. TABLER	DRAWN BY: J. TABLER	ENGR. CHCK BY: W. ANDERSON	PROJ. MGR.: W. CARTER	PROJ. NO.: 409735





LEGEND:

- ■ EXCELTECH SOIL SAMPLE
- ✳ IT CORPORATION SOIL SAMPLE
- ⊡ IT CORPORATION ARCHIVE SOIL SAMPLE
- △ EXCELTECH CONCRETE SAMPLE

SCALE:

0 30 60 FEET

FIGURE 2-18

WILLIAMS AIR FORCE BASE
SOIL SAMPLE LOCATIONS FOR
TANK 1086 (ST-07)

IT INTERNATIONAL TECHNOLOGY CORPORATION

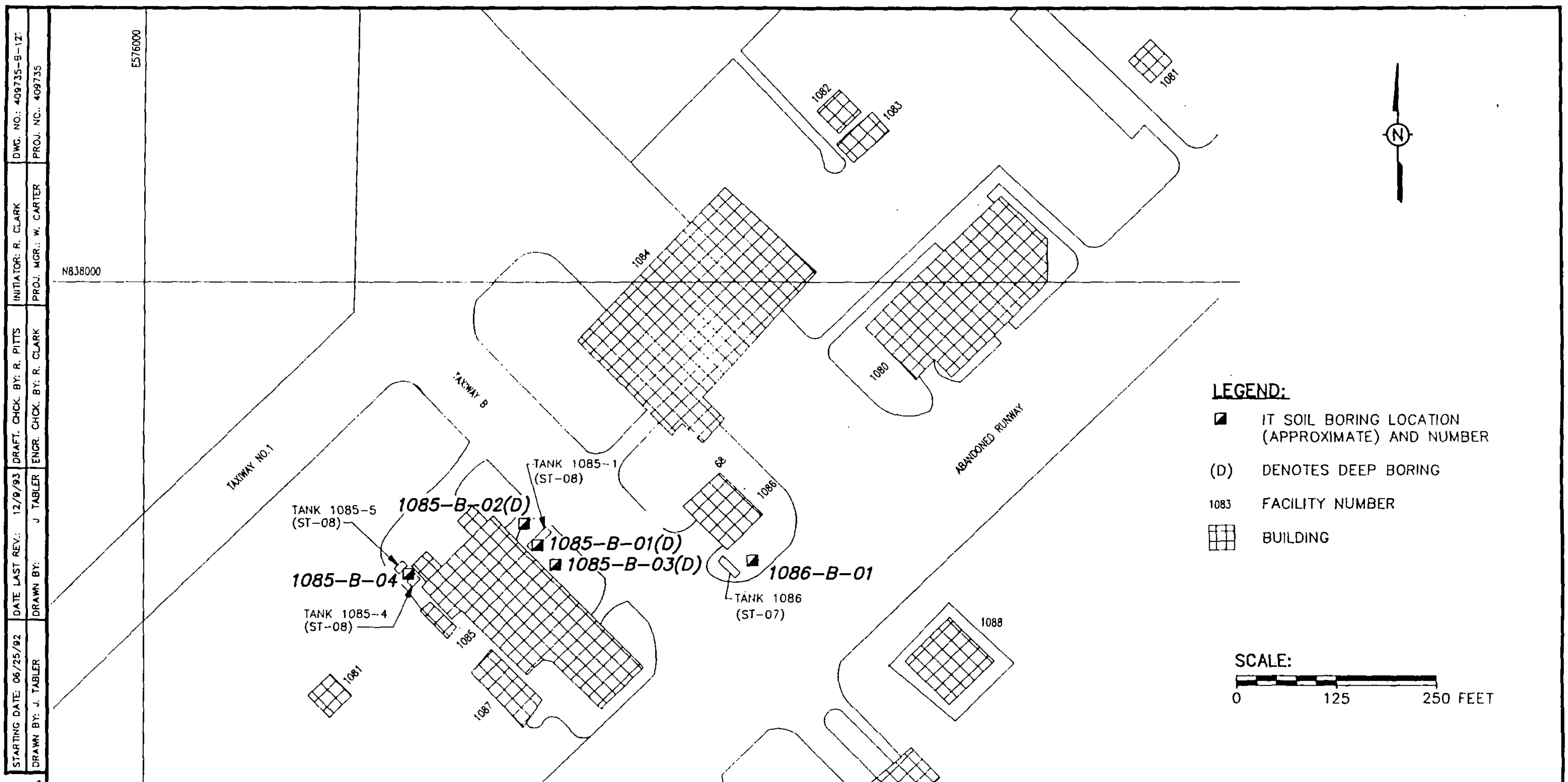


FIGURE 2-19
WILLIAMS AIR FORCE BASE
BUILDING 1086 (ST-07) AND
BUILDING 1085 (ST-08)
SOIL BORING LOCATIONS

INTERNATIONAL TECHNOLOGY CORPORATION

scope of AV's investigations. As a result, no characterization was performed at ST-08 during the Phase I or Phase II investigations.

2.2.10.3 Other Actions

Tracer Research Corporation investigated the tanks at ST-08 in 1987. Although the tests on the tanks were inconclusive, the tanks were later removed from service.

Surface soil samples were collected from the vicinity of the tanks at Building 1085 during March and May 1989. These samples were analyzed for TPH, benzene, toluene, ethyl benzene, and xylene (BTEX), and selected SVOCs. The surface soil sample locations are shown in Figures 2-20 and 2-21.

Soil samples were collected from the excavation in November and December of 1990 to identify tank leakage and characterize constituents of any contamination present. The tanks were removed and disposed of and the excavations were backfilled with uncontaminated soil. The excavated contaminated soil was shipped to the Butterfield Station Landfill for disposal. In September 1991, IT installed one shallow and three deep soil borings and collected soil samples for analyses. Locations of the borings are shown in Figure 2-19. Because there were detectable levels of contaminants below the bottom of the excavation for Tank No. 1085-1, this area was moved to OU-1 for final action. There were no detectable levels of contaminants below the bottoms of the Tank No. 1085-4 or 1085-5 excavations; therefore, these areas have been certified for clean closure in a RCRA Partial Closure Report (IT, 1992a).

2.3 Highlights of Community Participation

A community relations plan for the Base was finalized in February 1991 (IT, 1991e). This plan lists contacts and interested parties throughout the USAF, government, and local community. It also established communication pathways to ensure timely dissemination of pertinent information though mailings, public announcements in the local newspaper, and local information repositories.

The removal actions at sites RW-11 and DP-13 were described in two EE/CAs released to the public in June 1991. These documents were made available to the public in the Administrative Record. The notice of the availability of these documents was published in the *Arizona Republic/Phoenix Gazette* on June 17, 1991, which began the 30-day public comment period.

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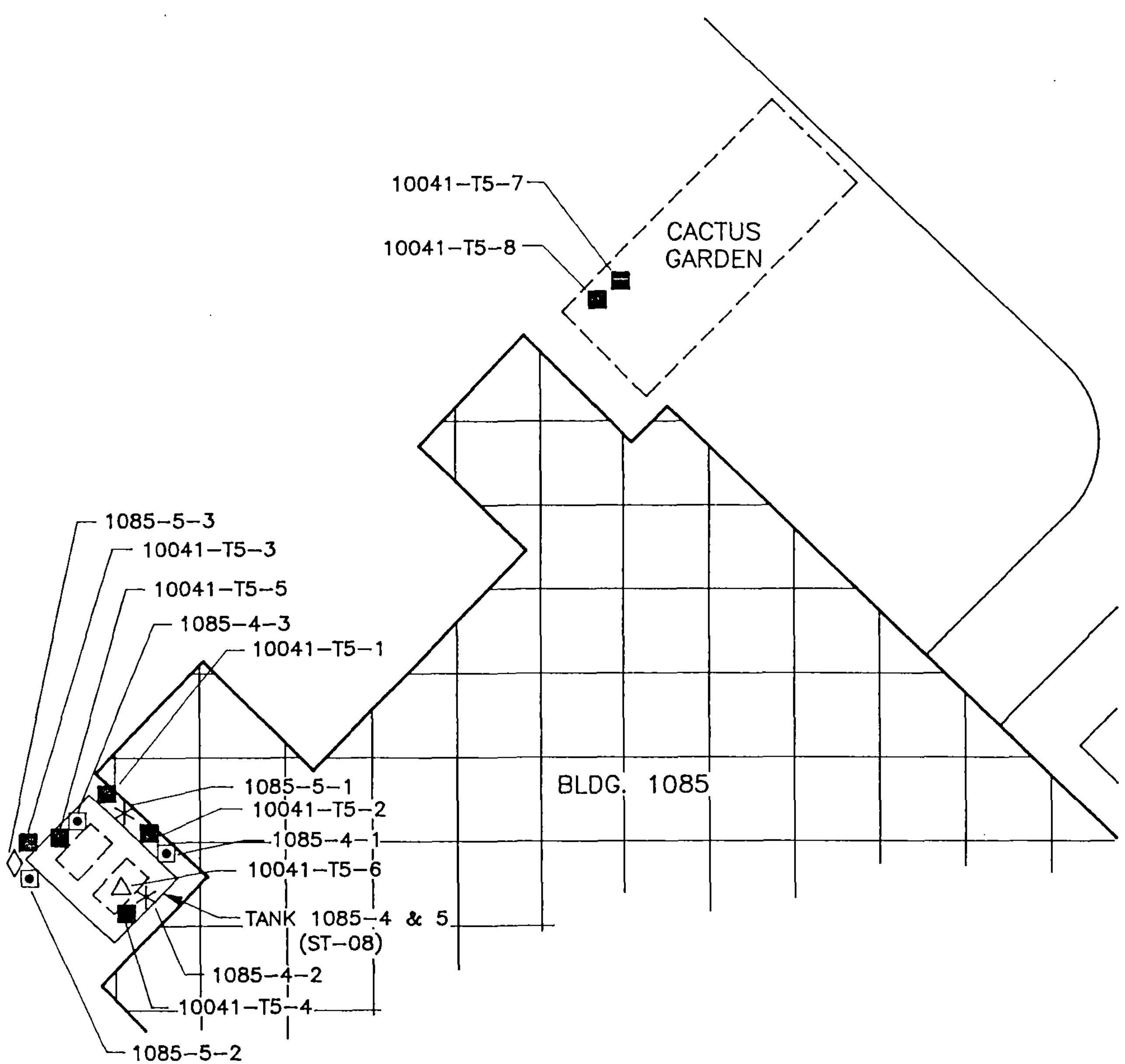
STARTING DATE: 8/31/93	DATE LAST REV.: 12/9/93	DRAFT. CHCK. BY: R. PITTS	INITIATOR: W. ANDERSON	DWG. NO.: 409735-A-122
DRAWN BY: J. TABLER	DRAWN BY: J. TABLER	ENGR. CHCK BY: W. ANDERSON	PROJ. MGR.: W. CARTER	PROJ. NO.: 409735



LEGEND:

- ■ EXCELTECH SOIL SAMPLE
- ✳ IT CORPORATION SOIL SAMPLE
- ⊡ IT CORPORATION ARCHIVE SOIL SAMPLE
- △ EXCELTECH CONCRETE SAMPLE
- ◇ IT CORPORATION SLUDGE SAMPLE

SCALE: 0 30 60 FEET

FIGURE 2-20

WILLIAMS AIR FORCE BASE
SOIL SAMPLE LOCATIONS FOR TANKS 1085-4 AND 1085-5 (ST-08)

INTERNATIONAL TECHNOLOGY CORPORATION

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STARTING DATE: 8/31/93	DATE LAST REV.: 12/9/93	DRAFT. CHCK. BY: R. PITTS	INITIATOR: W. ANDERSON	DWG. NO.: 409735-A-123
DRAWN BY: J. TABLER	DRAWN BY: J. TABLER	ENGR. CHCK BY: W. ANDERSON	PROJ. MGR.: W. CARTER	PROJ. NO.: 409735

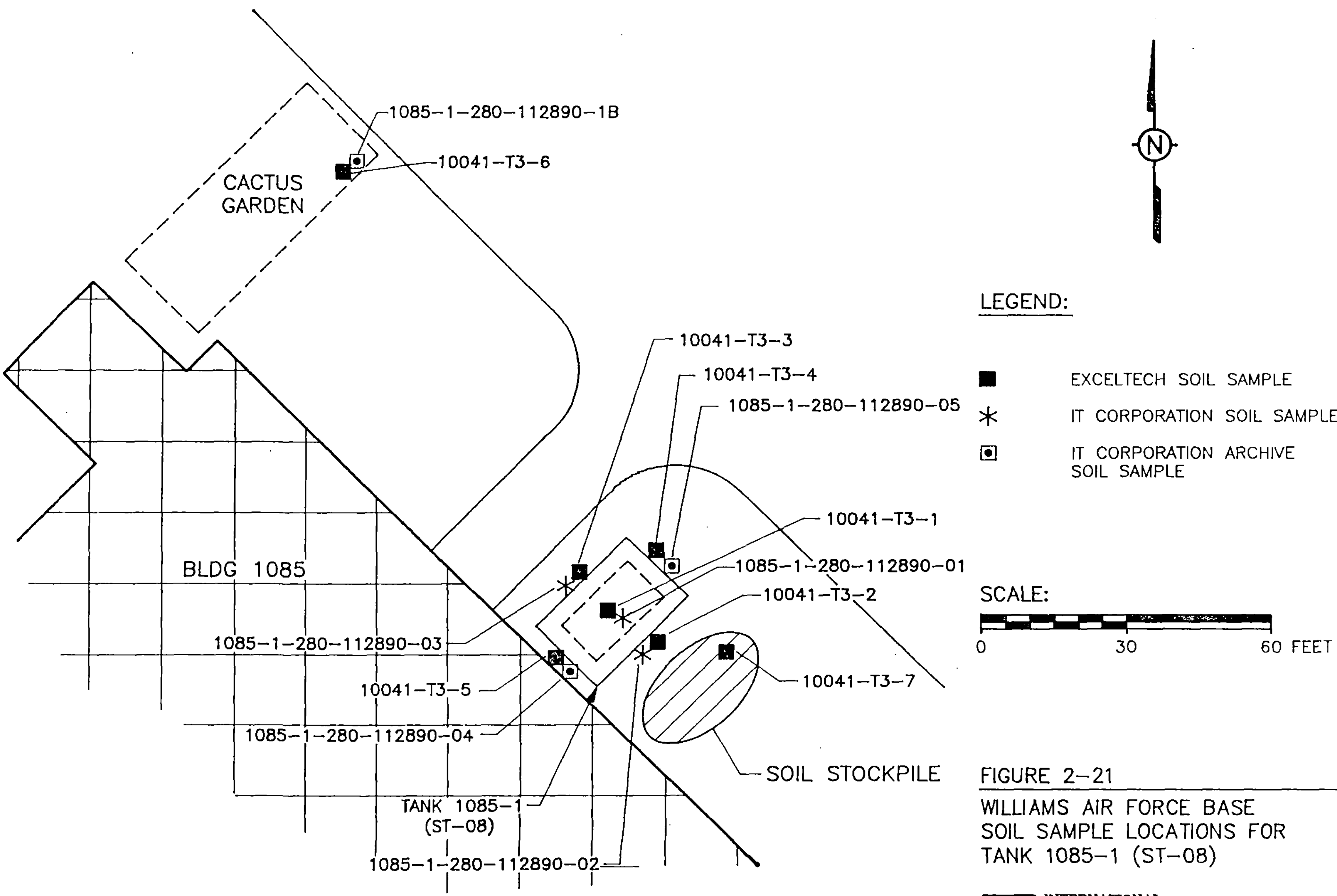


FIGURE 2-21

WILLIAMS AIR FORCE BASE
SOIL SAMPLE LOCATIONS FOR
TANK 1085-1 (ST-08)

INTERNATIONAL TECHNOLOGY CORPORATION

The OU-1 RI/FS was released for public review in October 1993. This release was followed by an announcement in the *Arizona Republic/Phoenix Gazette* of the issuance of an OU-1 Proposed Plan for public comment and a public meeting. The 30-day public comment period on the Proposed Plan began November 24, 1993, and a public meeting was held December 7, 1993 in the City of Mesa, Arizona, to discuss the proposed remedial alternatives. A resolution on groundwater at LF-04 prompted a revision of the FS and Proposed Plan, which was finalized in January 1994. An additional 30-day public comment period on the Proposed Plan began on January 28, 1994, and a second public meeting was held February 10, 1994 in the city of Mesa, Arizona, to discuss the proposed remedial alternatives. All comments received during both of the public comment periods are included in the Responsiveness Summary (Chapter 11.0), which also includes a response prepared by the USAF.

Technical Review Committee (TRC) meetings are held every 3 months with representatives of the USAF, regulatory agencies, and the community. The meetings provide a forum for members of the community that serve on this committee and give them the opportunity to be involved in decisions regarding investigation and Base cleanup activities.

An Administrative Record that contains the documents relating to investigation and cleanup activities proposed for the Base has been established and is available for public inspection at the Chandler Public Library, Chandler, Arizona and the Base Conversion Agency, Mesa, Arizona. Addition information is available through Williams AFB.

3.0 Scope and Role of Operable Unit

As with many Superfund sites, the problems at Williams AFB are complex. As a result, the USAF has organized the work into three operable units. These are:

- OU-1: Soil and groundwater contamination at the ten sites listed in Table 1-1.
- OU-2: Groundwater and soil to a depth of 25 feet at ST-12.
- OU-3: Soil and groundwater at SD-09 and FT-02, plus the deep soils below 25 feet at ST-12.

The principal risks to human health and the environment at OU-2 result primarily from contamination of soil and groundwater by jet propulsion fuel grade 4 (JP-4) and its constituents (e.g., benzene, toluene), although other organic compounds have also been detected at the site. The ROD for OU-2 was signed in December 1992. The selected remedy involves a combination of soil vapor extraction with bioenhancement to remediate affected soils to a depth of 25 feet, and groundwater extraction and treatment via air stripping with emission abatement to address the contaminated groundwater. The remedial design/remedial action phase for OU-2 is currently in progress with a pilot study/demonstration study on the treatment of contaminated groundwater. A pilot study on the treatment of contaminated soils is scheduled to begin by March 1994.

OU-1, addressed by this ROD, includes the contaminated soils and groundwater at ten sites. Of the ten sites within OU-1, only the Landfill (LF-04) presents an unacceptable risk to human health and the environment. Surface soils at LF-04 are contaminated with beryllium and the pesticide dieldrin at concentrations above remediation goals. The principal risks at this site are dermal contact with soil, incidental ingestion of soils, and inhalation of fugitive dust. The purpose of the remedial action selected in this ROD is to prevent current or future exposure to the contaminated surface soils at LF-04.

In addition to characterizing environmental contaminant conditions at SD-09 and ST-12, OU-3 was established to develop a comprehensive human health and ecological risk assessment for the entire base, an FS and ROD that will establish final remedial actions for FT-02, and a ROD that establishes final remedial actions for the whole of Williams AFB.

Additional operable units may be identified in the future as a result of these and other investigations. Also, because Williams AFB is closed, additional operable units may be utilized to expedite remedial action activities in accordance with Base reuse goals.

4.0 Summary of Site Characteristics

Chapter 4.0 provides an overview of the assessments conducted during the RI to characterize each site within OU-1. The summary of site characteristics presents the following information:

- Suspected sources of contamination
- Quantity, types, and concentration of hazardous substances
- Mobility, carcinogenicity, and volume of contaminants
- Lateral and vertical extent of contamination
- Potential surface and subsurface pathways of contaminant migration
- Current risks and potential routes of human and environmental exposure.

The suspected source of contamination at each site is identified in Sections 2.2.1.1 through 2.2.10.1 of the Decision Summary. Summary tables presented in this chapter are used to identify contaminants and their concentrations. A general discussion of the factors that determine contaminant mobility is presented in Section 4.2.1, and the chemical parameters that affect environmental transport and persistence are listed for each contaminant in Table 4-18 of this section. The carcinogenicity of site contaminants is characterized in Table 5-29. The volume of contamination is presented in this chapter for only the Landfill because it is the only site that requires remedial action. The lateral extent of contamination is depicted on site maps in this section and the vertical extent of contamination is described in the text by noting the maximum depth at which contamination was detected. Potential surface and subsurface pathways of contaminant migration for each site are discussed in Section 4.2.2.

The contaminant data presented in this section were collected over more than 9 years by two contractors. Williams AFB was added to the NPL in November 1989, and an FFA was signed on September 21, 1990. After July 1990, all analytical data collected were subject to EPA validation protocol. Before August 1990, analytical data were not validated. The signatories to the FFA agreed that both validated and nonvalidated data would be utilized in the baseline risk assessment and considered in the decision-making process where there was no evidence that the data were unacceptable for its intended purpose. This agreement is consistent with the management principles under the NCP regarding collection of additional data needed to develop and evaluate alternatives and to support design. Additional information on the use of validated and nonvalidated data in decision making can be found in the OU-1 RI (IT, 1992b) and FS reports (IT, 1994a).

4.1 Nature and Extent of Contamination

This section presents data that characterize the nature and extent of contamination for soil and groundwater for each of the ten sites at OU-1. For all ten sites, additional information on specific samples (sample dates, detection limits, etc.) are provided in Appendix A of the FS report. Regional background data for soil and groundwater are presented in Table 4-1 as a basis for comparison with the analytical results for site contaminants.

4.1.1 Landfill (LF-04)

Analytical results for both organic and inorganic constituents in LF-04 surface soils are presented in Table 4-2. All samples were collected at a depth of 0.5 foot below land surface (bls). Organic compounds detected included pesticides and SVOCs. Inorganic species detected above background concentrations are beryllium, lead, and zinc. The lateral extent of surface soil contamination at LF-04 is shown in Figure 4-1 by plotting the concentration data for dieldrin, beryllium, lead, and zinc. The volume of contaminated surface soil at LF-04 is estimated to be 59,000 cubic yards. The volume of buried landfill wastes is undetermined.

Groundwater sampling at monitoring wells crossgradient or downgradient of the landfill detected organic compounds such as BTEX, halogenated VOCs, and SVOCs. Ten inorganic constituents were detected above background concentrations. The analytical results for LF-04 groundwater monitoring are presented in Table 4-3.

Figure 4-2 maps the concentration data for organic and inorganic constituents detected in groundwater at LF-04.

4.1.2 Fire Protection Training Area (FT-03)

Results of the soil and groundwater investigation at the verified location of FT-03 during 1986 to 1989 indicated that soil and groundwater have not been impacted above acceptable health levels by site activities. This site therefore was not included in the risk assessment and is considered to be a no further investigation site. Low levels of VOCs and SVOCs were detected in soil samples. The results of the organic analyses are presented in Table 4-4. Two metals (antimony and silver) were detected above background concentrations (Table 4-5). Contaminants were detected to a depth of 150 feet bls.

The results of confirmatory surface soil sampling conducted in September 1993 are presented in Table 4-6. Bis(2-ethylhexyl)phthalate was detected in one sample at 0.79 milligrams per

Table 4-1
Background Inorganic Species Concentrations in Soil and Groundwater Williams Air Force Base

Constituent	Groundwater [a] (µg/L)	Soil [b] Base-Specific Average (mg/kg)	Soil [b] Base-Specific Range (mg/kg)	Soil [b] Regional Range [e] (mg/kg)
Antimony	NA [g]	ND [c]	ND (<12)	< 1
Arsenic	1 to 44	3.3	2.3 - 4.3	2 - 97
Barium	7 to 150	NA	NA	NA
Beryllium	<0.5 to 0.7	1.2	1.0 - 1.6	1.0 - 1.5
Cadmium	<1.0	ND (<1)	ND (<1)	0.01 - 2.0 [f]
Chromium	17.2 - 181 [h]	20.3	16.9 - 24.8	15 - 100
Cobalt	<3 to 3	NA	NA	NA
Copper	<10 to 30	ND (<5) [d]	ND (<5)	15 - 200
Lead	<10 to 14	15.8	10.4 - 19.4	10 - 100
Mercury	NA	ND (<0.2)	ND (<0.2)	0.01 - 0.5 [f]
Nickel	60.8 - 914 [h]	20.7	15.6 - 24.7	7 - 50
Nitrate (as N)	6,000 to 26,000 [i]	NA	NA	NA
Selenium	1 to 3	0.22	0.21 - 0.24	0.1 - 5
Silver	NA	ND (<2)	ND (<2)	0.01 - 8 [f]
Thallium	NA	ND (<2)	ND (<2)	0.1 - 0.8 [f]
Zinc	<3 to 38	ND (<4) [d]	ND (<4)	25 - 150

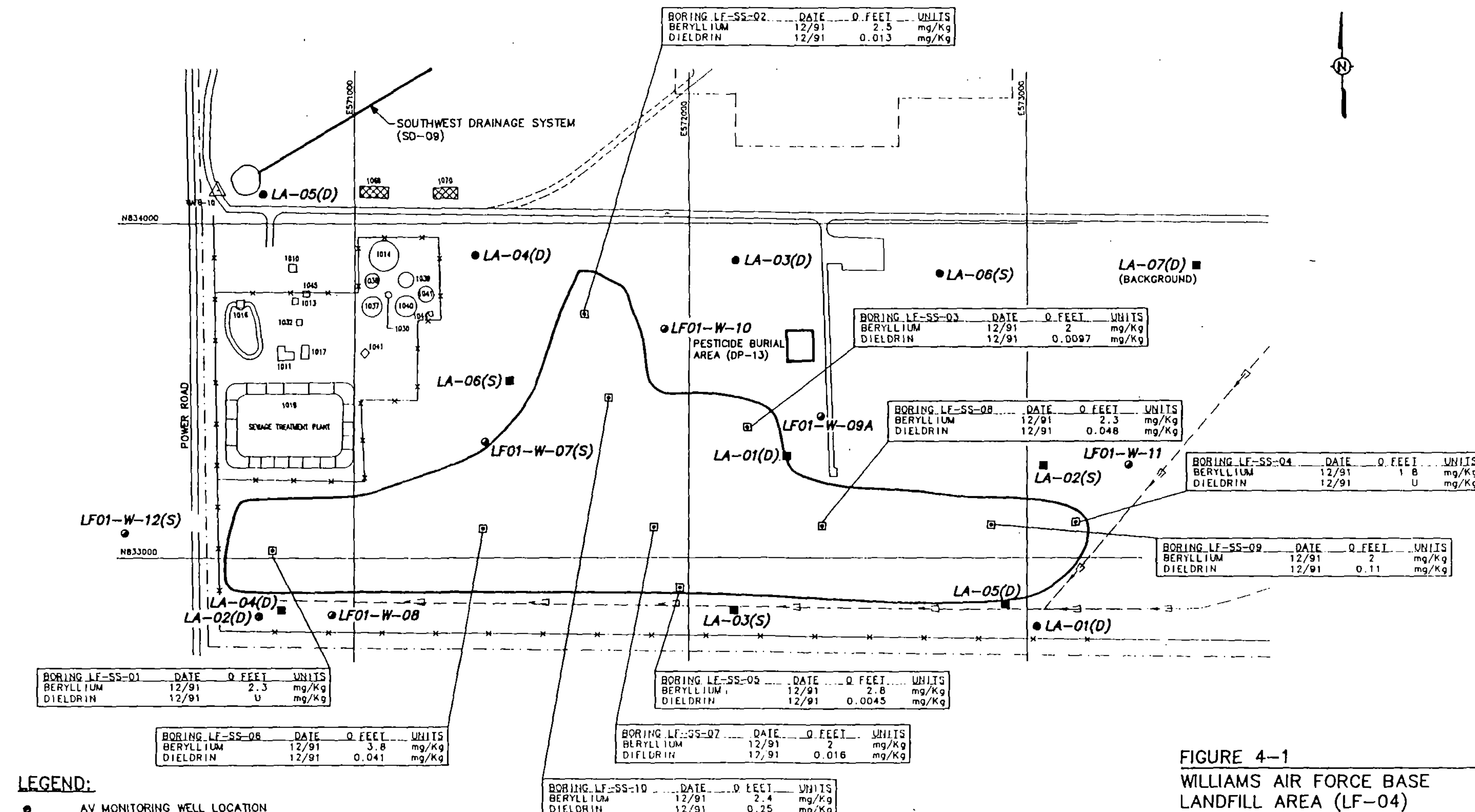
a Data obtained from U.S. Geological Survey WATSTORE Data Base using wells located within 10 miles of Williams AFB.
b The average soil concentration represents the mean of 10 surface soil samples collected at Williams AFB in September 1993. The range presents the low and high values for the 10 samples.
c ND = not detected.
d The analytical results for these constituents are qualified as not detected because of contamination in the method blanks.
e Data obtained from surficial soils in Gila, Maricopa, Pima, Pinal, and Yuma counties.
f Data obtained from Heavy Metals in Soils, B. J. Alloway, Editor; Appendix 2
g NA = not available or not used for comparison
h Data from September 1993 groundwater sampling round from wells LF01-W-12, SS01-W-10, SS01-W-17, SS01-W-26, and SS01-W-27.
i Data from Appendix E, OU-1 FS Report.

Table 4–2
Landfill(LF–04) Surface Soils, Organic And Inorganic Constitutents
Detected Constituents

	Boring Location									
	LF–SS–01	LF–SS–02	LF–SS–03	LF–SS–04	LF–SS–05	LF–SS–06	LF–SS–07	LF–SS–08	LF–SS–09	LF–SS–10
Compound (mg/Kg)	*8/90	8/90–	8/90–	8/90–	8/90–	8/90–	8/90–	8/90–	8/90–	8/90–
Pesticides										
4,4'–DDD			.0037			.0044 JP		.013 P	.0044 JP	
4,4'–DDE		.014	.012	.0021 J	.023	.091	.021	.083	.100	.015
4,4'–DDT		.070	.011		.006	.081	.017	.065	.052	.098
alpha–CHLORDANE			.0017 JP							
beta–BHC					.016 JP	.008 P		.0025 JP	.0019 JP	
Dieldrin		.013 J	.0097		.0045	.041	.016	.048	.110	.250
gamma–CHLORDANE			.0016 JP							
Semivolatile Organics										
1,2,4–trichlorobenzene				.037 J						
1,4–dichlorobenzene			.080 J	.035 J						
Acenaphthene				.038 J						
Benzo(A)pyrene								.034 J		
Bis(2–ethylhexyl)phthalate	.021 J	.023 J	.021 J	.039 J	.023 J		.037 J	.200 J	.080 J	.097 J
Chrysene								.022 J		
Diethylphthalate	.037 J									
Di–n–Butylphthalate	.026 J								.033 J	
Pentachlorophenol										
Pyrene				44 J						
Metals										
Arsenic	6.2 J	2.9 J	2.9	1.8 B	3.4	4.2	2.2	6.2	6.4	2.8
Beryllium	2.3	2.5	2	1.8	2.8	3.8	2	2.3	2	2.4
Cadmium								1.7		
Chromium	20.5	21.6	17.7	17.1	27.6	19.4	18.2	22.1	18	23.6
Copper	35.5	37.2	28.8	20.7	40.4	56.9	23.8	36	23.6	40.3
Lead	15.3	17.6	17	12.8	27.2	47.4	15	117	20.4	25
Nickel	16.3	19.2	16.6	11.7	28.9	23.3	17.1	18.5	15	21.1
Selenium					0.21 B					
Silver	1.1 B	1.4 B	1.7 B	1.7 B	1.5 B	1.5 B	1.8B	2.4	1.7B	2B
Thallium		0.23 B			0.29 B		0.23 B	0.24 B	0.35 B	0.36 B
Zinc	60.4	71.4	57.1	49.1	98.2	97.2	61.2	203	64.5	79.8

WAFB\TABLE\ROD\4–2.WK3\j\10–1–93

Notes:
*8/90 to present – All data collected after 7/90 have been validated, and all the qualifiers are validation qualifiers.
J – Estimated value (less than the sample quantitation limit)
B – Analyte concentration is between the Instrument Detection Limit and the Contract Detection Limit
P – Indicates 25% difference for detected concentrations between the two GC columns.



STARTING DATE: 8/11/92 | DATE LAST REV.: 2/24/93 | DRAFT. CHCK. BY: R. PITTS | INITIATOR: R. CLARK | DWG. NO.: 409735-B-74
DRAWN BY: G.P. | DRAWN BY: J. TABLER | ENGR. CHCK. BY: R. CLARK | PROJ. MGR.: W. CARTER | PROJ. NO.: 409735

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LEGEND:

- AV MONITORING WELL LOCATION AND NUMBER
- IT MONITORING WELL LOCATION AND NUMBER
- AV SOIL BORING LOCATION (APPROXIMATE) AND NUMBER
- IT SURFACE SOIL SAMPLE LOCATION (APPROXIMATE)
- (S) DENOTES SHALLOW BORING
- (D) DENOTES DEEP WELL/BORING
- U NONE DETECTED
- BASE BOUNDARY
- LANDFILL

NOTE:
SAMPLES LF-SS-06 THROUGH LF-SS-10 ARE COMPOSITE SAMPLES

SCALE:
0 300 600 FEET

FIGURE 4-1
WILLIAMS AIR FORCE BASE LANDFILL AREA (LF-04) CONCENTRATIONS IN SURFACE SOIL SAMPLES

INTERNATIONAL TECHNOLOGY CORPORATION

Table 4-3
Landfill (LF-04) Groundwater - Organic And Inorganic Constituents
Detected Constituents[a]
Page 1 of 2

	Well Number									
	LA-01		LA-02		LA-03		LA-04		LA-05	
Compound (ug/L)	[b]1/87 to 7/90	[c]8/90 -	1/87 to 7/90	8/90 -	1/87 to 7/90	8/90 -	1/87 to 7/90	8/90 -	1/87 to 7/90	8/90 -
Semivolatiles										
Benzoic Acid					3J					
Bis(2-ethylhexyl)phthalate	3J	2J-15		1J	3J	2J-10	7J	4J-150	2J	2J-8J
Diethylphthalate						2BJ				
Di-n-butylphtalate							12			
Naphthalene										
Volatiles										
Acetone	2J				2J		5J			
Benzene		0.7	0.8	0.8-1.4		1		380		0.6-0.9
Bromodichloromethane										
Bromoform										
Carbon disulfide	3J									
Chloroform										
Dibromochloromethane										
Ethyl Benzene		1.4		0.6		4				0.5
Methylene Chloride	1.4-6		1.6-3.2		1.9-7.6		1.4-6		1.7-2.9	
PCE										
TCE										
Toluene		3.5		1.2		8		0.5-1.4		0.8
Xylene (Total)		4				10				
Other										
TPH	2		2000		1000-4000		1000			
Metals										
Antimony	36.6 J	19.2 B		22.2 J				21.3 J		37.7 B
Arsenic				2 B						
Beryllium		1.1 B				1 B		1 B		1.4 B
Bromide			900-1,000				1,200		1,300-1,700	
Cadmium			9				13		6-13	
Chromium		4 B-5.6J				5.7 B		16.2		4.3 B-8.2 J
Copper		8.1B-10B		12.5 B		10B-11.1 B	9	10.7 J		6.8B-9.1 B
Lead		1.3B-2.6B	11	1.1 B-5.7		1B-1.2 B	90	1.3B-10.1	90	1J-2.9B
Maganese			0.24-0.27							
Mercury			0.3	0.24			0.3			
Nickel		9.8 B						15.3-16J	50	12.1 J
Nitrate	17,000-64,000	21,500	11,000-84,000	21,300	4,000-15,000	5,000	19,000-84,000	24,400	20,000-91,000	26,400
Selenium	1.4 J	1.6 B		1.2B-2B		2B-3.8 B		1.5 J	1.1J	1.7J-2.8B
Silver	3.4 J	7B-7,300	14	6.4-8.4B	7.9 B	5.7B-8.6 B	18	4.5B-7.7 B	13	3B-5.5B
Thallium		1.2 B		1.1 B						1 J
Uranium	0.003		0.003		0.003		0.003		0.005	
Zinc	1,100-1,900	21.6-158	20-1,600	13.1B-68.2	250-1,200	16.2B-456	430-1,800	18.3B-260	200-1,600	31.8-423

WAFB\TABLES\ROD4-3.WK3\JN0-1-93

Table 4-3
Landfill (LF-04) Groundwater - Organic And Inorganic Constituents
Detected Constituents [a]
Page 2 of 2

Compound (ug/L)	Well Number										
	LA-06		LF-01-W-07		LF-01-W-08		LF-01-W-09 A		LF-01-W-10	LF-01-W-11	LF-01-W-12
	[b] 1/87 to 7/90	[c] 8/90 -	1/87 to 7/90	8/90 -	1/87 to 7/90	8/90 -	1/87 to 7/90	8/90 -	8/90 -	8/90 -	8/90 -
Semivolatiles											
Benzoic Acid											
Bis(2-ethyl hexyl)phthalate			2J	3J-8J		2J-3J				7J	3J
Diethylphthalate								3J			3J
Di-n-butylphtalate				0.9J				3BJ			
Naphthalene											2J
Volatiles											
Acetone											
Benzene				0.5				0.9-6.1	2.7	0.9	
Bromodichloromethane				0.6	0.5	0.6-1.1					
Bromoform									0.8		
Carbon disulfide											
Chloroform				0.9	0.8	0.6-1.2					
Dibromochloromethane				0.5-0.8		0.9-1.2					
Ethyl Benzene		0.7		1.2				1.8-5.8	4		
Methylene chloride	1.8										
PCE			1-1.2	1.2-2.5	1.7-1.9	1.5-3.3		1-1.4	2.2-4.3		
TCE	0.7-0.8	0.5-0.7			1.2-1.4	1.2-2.4			0.9		
Toluene		1.2		1-1.5		0.5		4.4-18	0.6-10	0.9-3.9	
Xylene (Total)		2		4		1		4-16		4	
Other											
TPH			2000		2						
Metals											
Antimony		29.5 J		23.2 B		54.9 B					106
Arsenic		1.1 B		1.8B-1.9 B	2.4B	1.8 B-17.7		1.6 B			11.3
Beryllium		1J-1.5B		1.1 J		1 J-1.9 B		1.1B-1.3 J	1.3 J		
Bromide	900										
Cadmium	14	4 B								2.5B	
Chromium		4.3J-9.2 J		10.6-1,200		80.9-6,020		4B-1,100	8.1J-1,930	3.8B-822	3.8B-11,000
Copper			59.2	19.8B-45.9		6B-202		12.6B-24B	30	18.8-28.3	68.9
Lead		4.8-12.3	5	1.6B-2.1B		1.1B-2.4 B		1B-2.3J	1 J		
Maganese			0.1		0.09			80			
Mercury									0.22		
Nickel	30	10.6B-13.8 J	120-15,000	121-222	230	59-244	237	158-1,098	3.23J-202	51.5-270	64.5-1,080
Nitrate	17,000-91,000		6,000		13,000-17,100				21,700	13,200	9,800
Selenium		1.2 B		1 B-2.4 B		2.7 B		1B-2.4B		1J	
Silver	13	3.2B-9.5 B		5 B-11.6		4.4 B-11.1		6.1J-13.9	5.6 J	5J-7.9B	6.9 B
Thallium	NA	NA	NA	NA	NA	NA	NA	NA	NA		
Uranium	.002									16.7B-47.5	6.8B-125
Zinc	1,200-2,700	374-522	70	23.8-34.4	80	13.5B-96.4	20.5	32.7-50	71.9		

WAFB\TABLES\ROD4-3.WK3\JR-24-94

Notes:
[a] - the data presented is divided into collection times from 1/87 to 7/90 and 8/90 on to facilitate analysis of data that was not validated (collected from 1/87 to 7/90) and data that has been validated (collected from 8/90 on)
[b] 1/87 to 7/90 - All data collected in this time period are nonvalidated data, and all the qualifiers are laboratory qualifiers.
[c] 8/90 to present - All data collected after 7/90 have been validated, and all the qualifiers are validation qualifiers.
J - Estimated value (less than the sample quantitation limit)
B - Analyte concentration is between the Instrument Detection Limit and the Contract Detection Limit
P - Indicates 25% difference for detected concentrations between the two GC columns.

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Table 4-4
Fire Protection Training Area No. 1 (FT-03) Soil - Organic Constitutents
Detected Constituents

Compound (mg/kg)	Boring Number									
	FT01-B-01	FT01-B-02	F1-04	F1-06	F1-08	F1-10	F1-12	F1-05	F1-07	F1-11
	*1/87 to 7/90	*1/87 to 7/90	*1/87 to 7/90	*1/87 to 7/90	*1/87 to 7/90	*1/87 to 7/90	*1/87 to 7/90	*1/87 to 7/90	*1/87 to 7/90	*1/87 to 7/90
Semivolatiles										
1,2-Dichlorobenzene			4							
1,3-Dichlorobenzene			4			3				
1,4-Dichlorobenzene			5			3				
Bis(2-ethylhexyl)phthalate	.120J-.370	.042J-750 J								
Phenol	.040J									
Volatiles										
Acetone	.002BJ-.008J	.006J-.009 J								
Methylene Chloride	.002BJ-.024B	.005BJ-.026B	3	3	3-4	5	3-6	3	3	8
Other										
TPH	3-6	3-5								

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Notes:
* 1/87 to 7/90 - All data collected in this time period are nonvalidated data, and all the qualifiers are laboratory qualifiers.
J - Estimated value (less than the sample quantitation limit)
B - Analyte concentration is between the Instrument Detection Limit and the Contract Detection Limit
P - Indicates 25% difference for detected concentrations between the two GC columns.

Table 4-5
Fire Protection Training Area No. 1 (FT-03) Soil - Inorganic Constituents
Detected Constituents

Metals (mg/kg)	Boring Number						
	FT01-B-01	FT01-B-02	F1-01	F1-02	F1-03	F1-05	F1-04
	[a]1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90
Antimony	16-61	29-46					
Cadmium	2	2					
Chromium	4-23	9-15					
Copper	12-61	10-38					
Lead	6-12	7-14	11	21	11	10-20	10-20
Nickel	8-16	11-16					
Silver	4-12	3					
Zinc	30-80	40-63					

Metals (mg/kg)	Boring Number						
	F1-06	F1-07	F1-08	F1-09	F1-10	F1-11	F1-12
	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90
Antimony							
Cadmium							
Chromium							
Copper							
Lead	10-20	10-17	10-30	10-22	10	12-20	14-20
Nickel							
Silver							
Zinc							

WAFB\TABLES\RODM-5.WK3\\12-24-94

Notes:
[a] 1/87 to 7/90 - All data collected in this time period are nonvalidated data, and all the qualifiers are laboratory qualifiers.

TABLE 4-6
Fire Protection Training Area No.1 (FT-03) Surface Soil
1993 Confirmatory Sampling Data
Williams Air Force Base

Sample #		01-090193-01		02-090193-01		01-090293-02	
Compound	DL	CONC (mg/kg)	QUAL	CONC (mg/kg)	QUAL	CONC (mg/kg)	QUAL
Phenol	0.33	0.36	U	0.38	U	0.36	U
Bis(2-chloroethyl)ether	0.33	0.36	U	0.38	U	0.36	U
2-chlorophenol	0.33	0.36	U	0.38	U	0.36	U
1,3-dichlorobenzene	0.33	0.36	U	0.38	U	0.36	U
1,4-dichlorobenzene	0.33	0.36	U	0.38	U	0.36	U
1,2-dichlorobenzene	0.33	0.36	U	0.38	U	0.36	U
2-methylphenol	0.33	0.36	U	0.38	U	0.36	U
2,2'-oxybis(1-chloropropane)	0.33	0.36	U	0.38	U	0.36	U
4-methylphenol	0.33	0.36	U	0.38	U	0.36	U
N-nitroso-di-n-propylamine	0.33	0.36	U	0.38	U	0.36	U
Hexachloroethane	0.33	0.36	U	0.38	U	0.36	U
Nitrobenzene	0.33	0.36	U	0.38	U	0.36	U
Isophorone	0.33	0.36	U	0.38	U	0.36	U
2-Nitrophenol	0.33	0.36	U	0.38	U	0.36	U
2,4-dimentylphenol	0.33	0.36	U	0.38	U	0.36	U
Bis(2-chloroethoxy)methane	0.33	0.36	U	0.38	U	0.36	U
2,4-dichlorophenol	0.33	0.36	U	0.38	U	0.36	U
1,2,4-trichlorobenzene	0.33	0.36	U	0.38	U	0.36	U
Naphthalene	0.33	0.36	U	0.38	U	0.36	U
4-chloroaniline	0.33	0.36	U	0.38	U	0.36	U
Hexachlorobutadiene	0.33	0.36	U	0.38	U	0.36	U
4-chloro-3-methylphenol	0.33	0.36	U	0.38	U	0.36	U
2-methylnaphthalene	0.33	0.36	U	0.38	U	0.36	U
Hexachlorocyclopentadiene	0.33	0.36	U	0.38	U	0.36	U
2,4,6-trichlorophenol	0.33	0.36	U	0.38	U	0.36	U
2,4,5-trichlorophenol	0.8	0.88	U	0.93	U	0.87	U
2-chloronaphthalene	0.33	0.36	U	0.38	U	0.36	U
2-nitroaniline	0.8	0.88	U	0.93	U	0.87	U
Dimethylphthalate	0.33	0.36	U	0.38	U	0.36	U
Acenaphthylene	0.33	0.36	U	0.38	U	0.36	U
2,6-dinitrotoluene	0.33	0.36	U	0.38	U	0.36	U
3-nitroaniline	0.8	0.88	U	0.93	U	0.87	U
acenaphthene	0.33	0.36	U	0.38	U	0.36	U
2,4-dinitrophenol	0.8	0.88	U	0.93	U	0.87	U
4-nitrophenol	0.8	0.88	U	0.93	U	0.87	U
Dibenzofuran	0.33	0.36	U	0.38	U	0.36	U
4,5-dinitrotoluene	0.33	0.36	U	0.38	U	0.36	U
diethylphthalate	0.33	0.018	J	0.035	J	0.022	J
4-chlorophenyl phenylether	0.33	0.36	U	0.38	U	0.36	U
Fluorene	0.33	0.36	U	0.38	U	0.36	U
4-nitroaniline	0.8	0.88	U	0.93	U	0.87	U
4,6-dinitro-2-methylphenol	0.8	0.88	U	0.93	U	0.87	U
N-nitrosodiphenylamine(1)	0.33	0.36	U	0.38	U	0.36	U
4-bromophenyl-phenylether	0.33	0.36	U	0.38	U	0.36	U
Hexachlorobenzene	0.33	0.36	U	0.38	U	0.36	U
Pentachlorophenol	0.8	0.88	U	0.93	U	0.22	BJ
Phenanthrene	0.33	0.36	U	0.38	U	0.36	U
Anthracene	0.33	0.36	U	0.38	U	0.36	U
Carbazole	0.33	0.36	U	0.38	U	0.36	U
Di-n-butylphthalate	0.33	0.054	BJ	0.06	BJ	0.15	BJ
Fluoranthene	0.33	0.36	U	0.38	U	0.026	J
Pyrene	0.33	0.36	U	0.38	U	0.042	J
Butylbenzylphthalate	0.33	0.36	U	0.38	U	0.36	U
3-3'-dichlorobenzidine	0.33	0.36	U	0.38	U	0.36	U
Benzo(a)anthracene	0.33	0.36	U	0.38	U	0.023	J
Bis(2-ethylhexyl)phthalate	0.33	0.052	J	0.79		0.19	BJ
Chrysene	0.33	0.36	U	0.38	U	0.36	U
Di-n-octylphthalate	0.33	0.36	U	0.38	U	0.36	U
Benzo(b)fluoranthene	0.33	0.36	U	0.38	U	0.039	J
Benzo(k)fluoranthene	0.33	0.36	U	0.38	U	0.36	U
Benzo(a)pyrene	0.33	0.36	U	0.38	U	0.02	J
Indeno(1,2,3-c,d)pyrene	0.33	0.36	U	0.38	U	0.36	U
Dibenzo(a,h)anthrancene	0.33	0.36	U	0.38	U	0.36	U
Benzo(g,h,i)perylene	0.33	0.36	U	0.38	U	0.36	U

TABLE 4-6
Fire Protection Training Area No.1 (FT-03) Surface Soil
1993 Confirmatory Sampling Data
Williams Air Force Base

Sample # Compound	DL	090193-01 CONC (mg/kg)	090193-01 QUAL	090193-02 CONC (mg/kg)	090193-02 QUAL
Antimony	12	11.4	UJ	10.9	UJ
Arsenic	2	0.84	J	4.3	U
Beryllium	1	1.2		1.7	
Cadmium	1	0.92	U	0.87	U
Chromium	2	16		20.3	
Copper	5	49.7	U	24.7	U
Lead	0.6	22.6		19.4	
Mercury	0.2	0.018	U	0.17	U
Nickel	8	16.8		21.1	
Selenium	1	0.23	UJ	0.26	J
Silver	2	1.1	U	1.1	U
Thallium	2	0.68	U	0.65	U
Zinc	4	95.1	U	72.2	U

WAFB\TABLES\ROD\TAB4-6.WK3/lj/12-8-93

Notes:

U – Indicates the parameter was not detected.

J – Estimated value (less than the sample quantitation limit)

B – Analyte concentration is between the Instrument Detection Limit and the Contract Detection Limit kilogram (mg/kg), which is below acceptable health levels. Other organic compounds detected were at estimated concentrations below the contract required detection limit. Beryllium was the only inorganic constituent detected above background concentrations. The recent sampling results confirm that the isolated detections of antimony in early 1989 were analytical anomalies.

The results of groundwater monitoring at FT-03 show that four organics (acetone, carbon disulfide, methylene chloride, and toluene) and three inorganics (cadmium, lead and zinc) were detected at levels either equal to or below acceptable health levels. No other specific compounds were detected. Total Organic Carbon (TOC) and TPH were detected just at their respective detection limits in two samples.

4.1.3 Northwest Drainage System (SD-10)

Analytical results for both organic and inorganic compounds in SD-10 soils are presented in Table 4-7. VOCs and SVOCs were detected in samples collected from soil borings during the period 1984 to 1989. Four inorganic constituents were detected above background concentrations. Contaminants were detected to a depth of 40 feet bls.

The results of confirmatory surface soil sampling conducted in September 1993 are presented in Table 4-8. Beryllium, cadmium, and zinc were detected above background concentrations.

Groundwater was not monitored at SD-10 because there was no indication or evidence of a pathway to groundwater from suspect soils.

4.1.4 Radioactive Instrumentation Burial Area (RW-11)

Analytical results of all constituents detected in RW-11 soils during 1986 through 1989 are summarized in Table 4-9. No organic compounds were detected at RW-11. Three samples slightly exceed the background activity for radium-226 at depths of 19.5 and 29.5 feet. All soils fell within the background range for uranium and radium-228. Some of the analyses for gross alpha and gross beta activities also slightly exceeded site-specific background concentrations.

Confirmatory samples collected in December 1992 indicate that the radionuclide activity level in soil immediately adjacent to the concrete footings is consistent with the levels of the background sample collected approximately 200 feet south of RW-11. Radium activities are consistent with background activities in U.S. soils. Uranium values for the removal samples

Table 4-7
Northwest Drainage System (SD-10) Soil - Inorganic And Organic Constitutents
Detected Constituents
Page 1 of 2

Compound (mg/kg)	Boring Number								
	Surface Soil Sample	SD-10	NW-01	NW-02	NW-03	NW-04	NW-05	NW-06	NW-07
	* 1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90
Semivolatiles									
1,3 Dichlorobenzene									
Benzo(b)Fluorene								.320	
Benzo(a)anthracene								.110	
Bis(2-ethylhexyl)phthalate									
Butylbenzylphalate									
Chrysene								.00018	
Di-n-octylphthalate									
Fluoranthene								.160	
Phenol									
Phenols (total)					.7	1.6			
Pyrene								.170	
Volatiles									
1,1,2,2-Tetrachlorethane									
Acetone	.025-.053								
Chlorobenzene									
Chloroform								2	
Chlorotoluene									
MEK				.016					
Methylene Chloride	.016-.027	.003-.006					3-4	4	
PCE									
TCE						2	2		
Toluene									
Other									
Oil/Grease			.320	110	60	180			
TOX			.001	1		1			
TPH	2-5							200	
Metals									
Antimony	26								
Arsenic	3								
Beryllium							0.55-1.3	0.42-1.1	0.52-1.2
Cadmium								1	
Chromium, Total	11						13-26	11-32	17-23
Copper	12-17						18-40	18-510	21-95
Lead	11-17		67	10-40	19-29	21-38	9-22	8-33	11-16
Mercury									
Nickel	14-15						11-24	8-18	9-18
Silver							1.2-1.9	1.4-4.1	1.3
Zinc	44-53						36-80	43-440	42-84

WAFB\TABLES\ROD\4-6.WK3\jj\10-1-93

Table 4-7
Northwest Drainage System (SD-10) Soil - Inorganic And Organic Constitutents
Detected Constituents

	Boring Number								
	NW-08	NW-09	NW-10	NW-11	NW-12	OT-02-SS-01	OT-02-SS-02	OT-02-SS-03	OT-02-SS-04
Compound (mg/kg)	*1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90
Semivolatiles									
1,3 Dichlorobenzene					.024				
Benzo(a)anthracene									
Benzo(b)Fluorene									
Bis(2-ethylhexyl)phthalate		2.8				2.6-3.5	5-9.5	2.9-4.9	.530-12
Butylbenzylphalate									.063J
Chrysene									
Di-n-octylphthalate						.130J			
Fluoranthene									
Phenol							.370J-.820	.330J-.620	.092J-.530J
Phenols (Total)									
Pyrene									
Volatiles									
1,1,2,2-Tetrachlorethane					.001				
Acetone						.004J-.008J	.004J-.005J	.003J-.006	.004J-.006J
Chlorobenzene					6				
Chloroform	2	2	.001		1-2				
Chlorotoluene					24				
MEK									
Methylene Chloride	2	3			3	.020-.035	.020-.024	.019-.022	.015-.017
PCE					1				
TCE			.001						
Toluene						.001J-.002J	.001J		
Other									
Oil/Grease									
TOX									
TPH									3
Metals									
Antimony						28-34			14-18
Arsenic							2-3	5	4
Beryllium	0.62-1.8	0.37-1.1	0.25-1.3	0.5-1.3	0.48-1.2				
Cadmium	1.3				1.5				
Chromium, Total	17-42	9-21	6.3-34	9.9-28	9.3-31	12-14	10-13	9-12	5-16
Copper	19-71	20-60	28-94	14-47	26-61	10-12	9-14	6-14	8-16
Lead	12-39	12-20	8-18	8-16	8-54	3-10	2-11	5-9	8-15
Mercury	0.2								
Nickel	13-34	7-24	5-24	10-22	6-24	12	11-14	11	10-20
Silver	1-1.1	1-2.1	1.5	1.3-1.6	0.9-1.1				
Zinc	47-170	35-95	31-75	38-70	58-100	39-42	45-52	27-45	27-69

WAFB\TABLES\ROD\4-6.WK3\j\10-1-93

Notes:
* 1/87 to 7/90 - All data collected in this time period are nonvalidated data, and all the qualifiers are laboratory qualifiers.
J - Estimated value (less than the sample quantitation limit)
B - Analyte concentration is between the Instrument Detection Limit and the Contract Detection Limit
P - Indicates 25% difference for detected concentrations between the two GC columns.
TPH - Total Petroleum Hydrocarbons
MEK - Methyl ethyl ketone, (2-butanone)

TABLE 4-8
Northwest Drainage System, (SD-10) Surface Soil
1993 Confirmatory Sampling Data
Williams Air Force Base

Sample # / Compound	DL	090293-01 CONC (mg/kg)	090293-01 QUAL	090293-02 CONC (mg/kg)	090293-02 QUAL	090293-03 CONC (mg/kg)	090293-03 QUAL	090293-04 CONC (mg/kg)	090293-04 QUAL	090903-05 CONC (mg/kg)	090903-05 QUAL
Antimony	12	11.5	U	12	U	13.8	U	11.9	U	11	U
Arsenic	2	3.1		4.5		4.1		4.1		3.6	
Beryllium	1	0.96	B	1.8		1.9	U	1.8		0.88	U
Cadmium	1	2.2		0.96	U	1.1		0.95	U	0.88	U
Chromium	2	21.9		28.6		31.4		28.2		22.5	
Copper	5	44.6		33.1		38.9		30.4		28.6	
Lead	0.6	70.8		30.1		34		32.3		23.8	
Mercury	0.2	0.17	U	0.21		0.27		0.19	U	0.17	
Nickel	8	24.4		35		29.1		32.5		24.2	
Selenium	1	0.23	U	0.24	U	0.39	B	0.25	U	0.44	U
Silver	2	1.1	U	1.2	U	1.4	U	1.2	U	1.1	U
Thallium	2	0.68	U	0.73	U	0.83	U	0.74	U	0.44	U
Zinc	4	218		129		134		114		171	

WAFB\ROD\TABLES\TAB4-8.WK3/lj/12-8-93

Notes:

U – Indicated the parameter was not detected.

J – Estimated value (less than the sample quantitation limit)

B – Analyte concentration is between the Instrument Detection Limit and the Concract Detection Limit.

Table 4-9
Radioactive Instrumental Burial Area (RW-11) Soils - Organic Constituents
Detected Constituents

	Boring Number/Sample Location					
	RA-01	RA-02	RA-03	RW-SS-01	RW-SS-02	20013
Compound (pCi/g)	[a] 1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90
Gross Alpha	2.8-5.8	3.1-5.6	3.8-5.9	15-26	21-27	16
Gross Beta	6.1-6.8	4.5-6.1	4.3-6.5	21-27	17-26	23
Ra-226	1.8-2	1.5-2.2	1.5-2.3	0.77-0.92	0.82-1	0.83
Ra-228				1.03-1.23	1.13-1.3	1.24
Uranium (total)	0.4-.09	0.6-1.3	0.9-1.4	1.03-1.22	1.03-1.45	1.3

WAFB\TABLES\ROD\4-7.WK3\lj\2-24-94

Notes:
[a] 1/87 to 7/90 - All data collected in this time period are nonvalidated data, and all the qualifiers are laboratory qualifiers.
J - Estimated value (less than the sample quantitation limit)
B - Analyte concentration is between the Instrument Detection Limit and the Contract Detection Limit
P - Indicates 25% difference for detected concentrations between the two GC columns.

are somewhat elevated relative to previous RI/FS samples; however, they are internally consistent and agree within the uncertainty of the measurements. The uranium activities in the removal samples are within the possible ranges of background activities in U.S. soils, particularly where uranium minerals are present.

Groundwater was not monitored at RW-11 because there was no indication or evidence of a pathway to groundwater from suspect soils.

4.1.5 Pesticide Burial Area (DP-13)

Analytical results of all organic and inorganic compounds detected in DP-13 soils are summarized in Table 4-10. Acetone, methylene chloride, and bis(2-ethylhexyl)phthalate were detected in samples from soil borings at the site. Pesticides were detected in surface soil samples but not in the deeper soils. Antimony was the only inorganic constituent detected above background concentrations. Contaminants were detected to a depth of 30 feet bls.

Groundwater was not sampled at this site because there is no indication or evidence that the suspected contaminants could migrate to groundwater.

4.1.6 Hazardous Materials Storage Area (SS-01)

Analytical results of all organic and inorganic compounds detected in SS-01 soils are summarized in Table 4-11. Various VOCs and SVOCs were detected in soils. Beryllium and copper were the only metals detected above background concentrations. The areal extent of beryllium detected at SS-01 is shown in Figure 4-3. Contaminants were detected to a depth of 80 feet bls.

No groundwater samples were collected from this site because there is no indication or evidence that the suspected contaminants could be transported to groundwater.

4.1.7 USTs at Building 789 (ST-05)

Analytical results of all organic compounds detected in ST-05 soils are summarized in Table 4-12. Toluene, ethyl benzene, and xylenes were detected in the three samples collected from the tankhold excavation in December 1990. Results from subsequent September 1991 borings indicate that ethyl benzene and xylenes were detected to 31 feet bls. Soil samples were analyzed for TCLP lead, but lead was not detected.

Table 4-10
Pesticide Burial Area (DP-13) Soil - Organic And Inorganic Constitutents
Detected Constitutents[a]
Page 1 of 2

	Boring Number/Sample Location								
	20000	20001	20002	20003	20004	20012	WP-B-01	WP-B-02	Pe-01
Compound (mg/kg)	[b] 1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90
Pesticides									
4,4'-DDE	.014J			.017J	.018				
4,4'-DDT									
Dieldrin			.019J	.016J					
Gamma-BHC(Lindane)									
Semivolatiles									
Benzo(b)fluoranthene	.079J								
Bis(2-ethylhexyl)phthalate	.038J			.760			14-38	.980-65	
Chrysene	.039J								
Di-n-butylphthalate				.140J					
Fluoranthene	.043J								
Phenol							.610	.590	
Pyrene	.045J								
Volatiles									
Acetone	.018	.017	.013	.027	.003J	.004J	.003J-.007J	.002J-.012	
Bromodichloromethane									
MEK				.002J					
Methylene Chloride	.022	.026	.015	.021	.016	.006	.020-.027	.007-.008	
Toluene								.002J-.003J	
Xylenes (Total)									
Other									
TOX									11B
Metals									
Antimony							22-52	20	
Arsenic							2-3	4	
Beryllium							1		
Chromium							14-18	5-16	
Copper							26-34	19-63	
Lead							9-22	8-11	
Nickel							11-16	8-21	
Zinc							61-72	42-63	

WAFB\TABLES\ROD\4-8.WK3/9-28-93

Table 4-10
Pesticide Burial Area (DP-13) Soil - Organic Constitutents
Detected Constitutents[a]

	Boring Number/Sample Location						
	20015	20016	20020	20023	20024	20025	20026
Compound (mg/kg)	[c] 8/90 -	8/90 -	8/90 -	8/90 -	8/90 -	8/90 -	8/90 -
Pesticides							
4,4'-DDE							
4,4'-DDT		.024					
Dieldrin		.520					
Gamma-BHC(Lindane)		.019					
Semivolatiles							
Benzo(b)fluoranthene							
Bis(2-ethylhexyl)phthalate							
Chrysene							
Di-n-butylphthalate							
Fluoranthene							
Phenol							.082J
Pyrene							
Volatiles							
Acetone	.180		.006J	.006J	.006J	.009J	.007J
Bromodichloromethane						.039	
MEK							
Methylene Chloride							
Toluene							.006
Xylenes (Total)	.002J						
Other							
TOX							
Metals							
Antimony							
Arsenic							
Beryllium							
Chromium							
Copper							
Lead							
Nickel							
Zinc							

WAFB\TABLES\ROD\4-8.WK3/9-28-93

Notes:
[a] - the data presented is divided into collection times from 1/87 to 7/90 and 8/90 on to facilitate analysis of data that was not validated (collected from 1/87 to 7/90) and data that has been validated (collected from 8/90 on)
[b] 1/87 to 7/90 - All data collected in this time period are nonvalidated data, and all the qualifiers are laboratory qualifiers.
[c] 8/90 to present - All data collected after 7/90 have been validated, and all the qualifiers are validation qualifiers.
J - Estimated value (less than the sample quantitation limit)
B - Analyte concentration is between the Instrument Detection Limit and the Contract Detection Limit
P - Indicates 25% difference for detected concentrations between the two GC columns.
TPH - Total Petroleum Hydrocarbons
MEK - Methyl ethyl ketone, (2-butanone)

Table 4-11
Hazardous Materials Storage Area (SS-01) Soils - Inorganic And Organic Constitutents
Detected Constituents [a]

Compound (mg/kg)	Boring Number/Sample Location								
	HM-01	HM-02	HM-03	HM-04	HM-05	HM-06	HM-07	HM-08	HM-09
	[b]1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	1/87 to 7/90
Semivolatiles									
1,2-Dichlorobenzene	7				10		10		
1,3-Dichlorobenzene	6								
1,4-Dichlorobenzene	5			2	2-8				
Diethylphthalate									
Di-n-Butylphthalate									
Volatiles									
Acetone									
Chlorobenzene					3				
Chloroform									
Ethylbenzene	2	2		2	2-4				
Methylene Chloride									4
Toluene									
Xylenes	3-5	3		3	12				
Other									
TPH									
Metals									
Arsenic									
Beryllium	0.35-1.1	0.68-0.96	0.63-1.4	0.74-1.1	0.73-1.1	0.74-1.4	0.97-1.6	1.74-0.74	0.62-0.84
Cadmium							0.6	0.7	0.9
Chromium	7.4-11	12-22	11-23	15-40	11-23	15-24	20-88	12-24	12-15
Copper	12-49	12-43	13-85	19-34	21-47	21-51	17-380	14-39	22-42
Lead	7-24	11-20	11-23	12-24	10-21	11-22	16-26	12-23	10-17
Mercury									
Nickel	7-25	15-22	13-30	15-27	14-21	16-27	18-29	15-28	15-20
Silver	1.9	1.4	0.9-1.8	1.1-2.6	0.99-1.8	0.9-2	1.1-2.4	1.1-2.6	1.1-1.9
Zinc	31-100	42-72	47-88	46-84	44-100	53-110	54-150	36-85	45-62

WAFB\TABLES\ROD\4-10.WK3\j\10-1-9

Table 4–11
Hazardous Materials Storage Area (SS–01) Soils – Inorganic And Organic Constitutents
Detected Constituents[a]

	Boring Number/Sample Location						
	HM–10	HM–11	HM–12	HM–B–13	HM–B–14	HM–B–15	HM–B–16
Compound (mg/kg)	[b]1/87 to 7/90	1/87 to 7/90	1/87 to 7/90	[c]8/90 –	8/90 –	8/90 –	8/90 –
Semivolatiles							
1,2–Dichlorobenzene			4				
1,3–Dichlorobenzene			3				
1,4–Dichlorobenzene			3				
Diethylphthalate						.025J–.049J	.036J–.049J
Di–n–Butylphthalate					.0023J	.020J	.020J–.023J
Volatiles							
Acetone				.002J–.009J	.006J–.009J		
Chlorobenzene							
Chloroform	4	3					
Ethylbenzene							
Methylene Chloride	3	3	14–21				
Toluene			2				
Xylenes			3				
Other							
TPH		400	260				
Metals							
Arsenic				2.2–6	2.8–3.9	3.1–4.7	2.7–3.4
Beryllium	0.84–1.3	0.7–1.4	0.54–2.1	0.86J–1.5	0.81J–1.5	1.1J–1.6	1.4–1.9
Cadium	0.6–0.7	0.7	0.6–0.8				0.63J
Chromium	16–20	14–21	13–26	12.7–24.5	16.5–27.8	22–25.1	23.1–32.7
Copper	16–64	16–38	12–38				21.1–25.5
Lead	16–19	13–24	11–32	21–22.3			15.3–28.6
Mercury				0.17	0.17		
Nickel	19–24	15–26	13–36	11.8–22.1	12.5–19	10.9–17.7	11.9–17.5
Silver	1.2–2.2	1.3	1–1.8				1.6J
Zinc	46–91	40–77	38–110	72.4J		45.5J	60.1–67.1

WAFB\TABLES\ROD\4–10.WK3\JA\10–1–93

Notes:

[a] – the data presented is divided into collection times from 1/87 to 7/90 and 8/90 on to facilitate analysis of data that was not validated (collected from 1/87 to 7/90) and data that has been validated (collected from 8/90 on)

[b] 1/87 to 7/90 – All data collected in this time period are nonvalidated data, and all the qualifiers are laboratory qualifiers.

[c] 8/90 to present – All data collected after 7/90 have been validated, and all the qualifiers are validation qualifiers.

J – Estimated value (less than the sample quantitation limit)

B – Analyte concentration is between the Instrument Detection Limit and the Contract Detection Limit

P – Indic[illegible] 25% difference for detected concentrations between the two GC columns.

TPH – T[illegible] etroleum Hydrocarbons

MEK – Methyl ethyl ketone, (2–butanone)

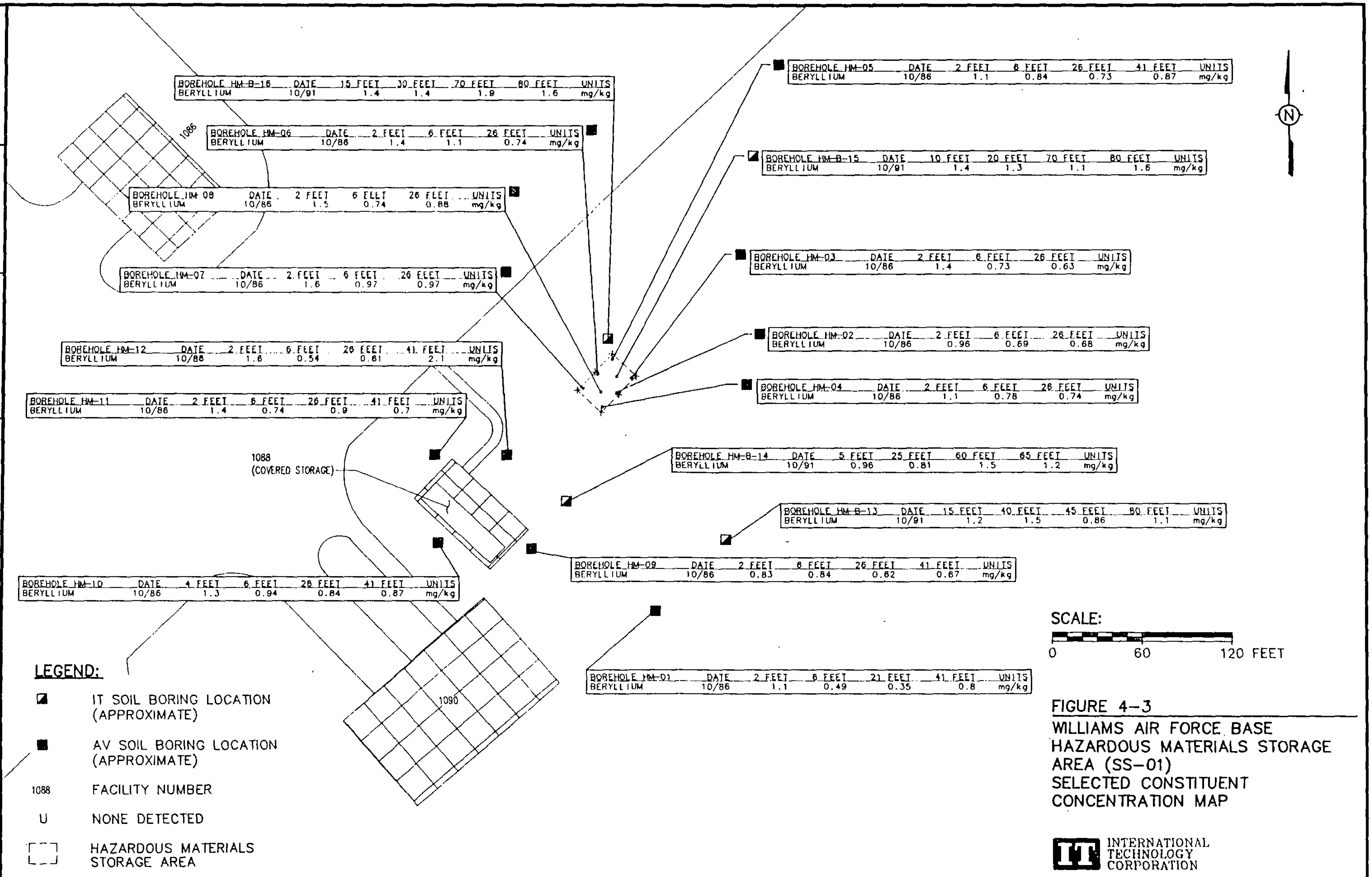


FIGURE 4-3
WILLIAMS AIR FORCE BASE
HAZARDOUS MATERIALS STORAGE AREA (SS-01)
SELECTED CONSTITUENT CONCENTRATION MAP

INTERNATIONAL TECHNOLOGY CORPORATION

DWG. NO.: 409735-B-125 | PROJ. NO.: 409735
INITIATOR: W. ANDERSON | PROJ. MGR.: W. CARTER
DRAFT. CHCK. BY: R. PITTS | ENGR. CHCK. BY: W. ANDERSON
DATE LAST REV.: 12/1/93 | DRAWN BY: J. HUBBARD
STARTING DATE: 06/25/92 | DRAWN BY: S. CARDWELL

409735 OU1-ROD
97350125 12/01/93 10:07am JWH

Table 4-12
Underground Storage Tanks (ST-05) Soils - Organic Constitutents
Detected Constituents

Compound (mg/kg)	Boring Number/Sample Location					
	North Side of Tank T-1 Excavation	West Side of Tank T-1 Excavation	Stockpiled Soil From Tank T-5 Excavation	Boring ST05-01	Boring ST05-02	Boring ST05-03
	[a] 8/90 -	8/90 -	8/90 -	8/90 -	8/90 -	8/90 -
Ethylbenzene	4.890-10.100		.005	.008	12.1	49.2
Toluene	1.950-4.830					
Xylenes	63.300-73.700		.021	.025	43.4	299
HBFH	510-530	.027	35	16	1,660	980

WAFB\TABLES\ROD\4-10.WK3\lj\10-3-93

Notes:

[a]8/90 to present - All data collected after 7/90 have been validated, and all the qualifiers are validation qualifiers.

J - Estimated value (less than the sample quantitation limit)

B - Analyte concentration is between the Instrument Detection Limit and the Contract Detection Limit

P - Indicates 25% difference for detected concentrations between the two GC columns.

HBFH - High Boiling Fuel Hydrocarbons

Groundwater at this site was not monitored because there was no indication or evidence of a pathway to groundwater from the suspect soils.

4.1.8 USTs at Building 725 (ST-06)

Analytical results of all organic compounds detected in ST-06 soils are summarized in Table 4-13. Ethyl benzene and xylene were detected in one sample at 11 feet bls. Soil samples collected in November 1990 and September 1991 were analyzed for TCLP lead. Lead was not detected in any analysis. Figure 4-4 shows the locations of soil borings and soil sample locations at the old Higley gas station.

Groundwater at this site was not monitored because there was no indication or evidence of a pathway to groundwater from the suspect soils.

4.1.9 USTs at Building 1086 (ST-07)

Analytical results of all organic compounds detected during the 1990 and 1991 sampling events are summarized in Table 4-14. Results of the 1990 sampling efforts indicate that methylene chloride and TPH were detected in the samples. Methylene chloride was also detected in the associated method blank. The areal extent of methylene chloride and TPH contamination is presented in Figure 4-5. Soil samples collected during 1990 and 1991 were analyzed for TCLP metals. No contaminants were detected in TCLP extracts above RCRA regulatory limits. Contaminants were detected to a depth of 41 feet bls.

Groundwater at this site was not monitored because there was no indication or evidence of a pathway to groundwater from the suspect soils.

4.1.10 USTs at Building 1085 (ST-08)

Analytical results of all organic compounds detected during the 1989, 1990, and 1991 sampling events are summarized in Table 4-15. Soil sampling locations are shown in Figures 4-6 and 4-7.

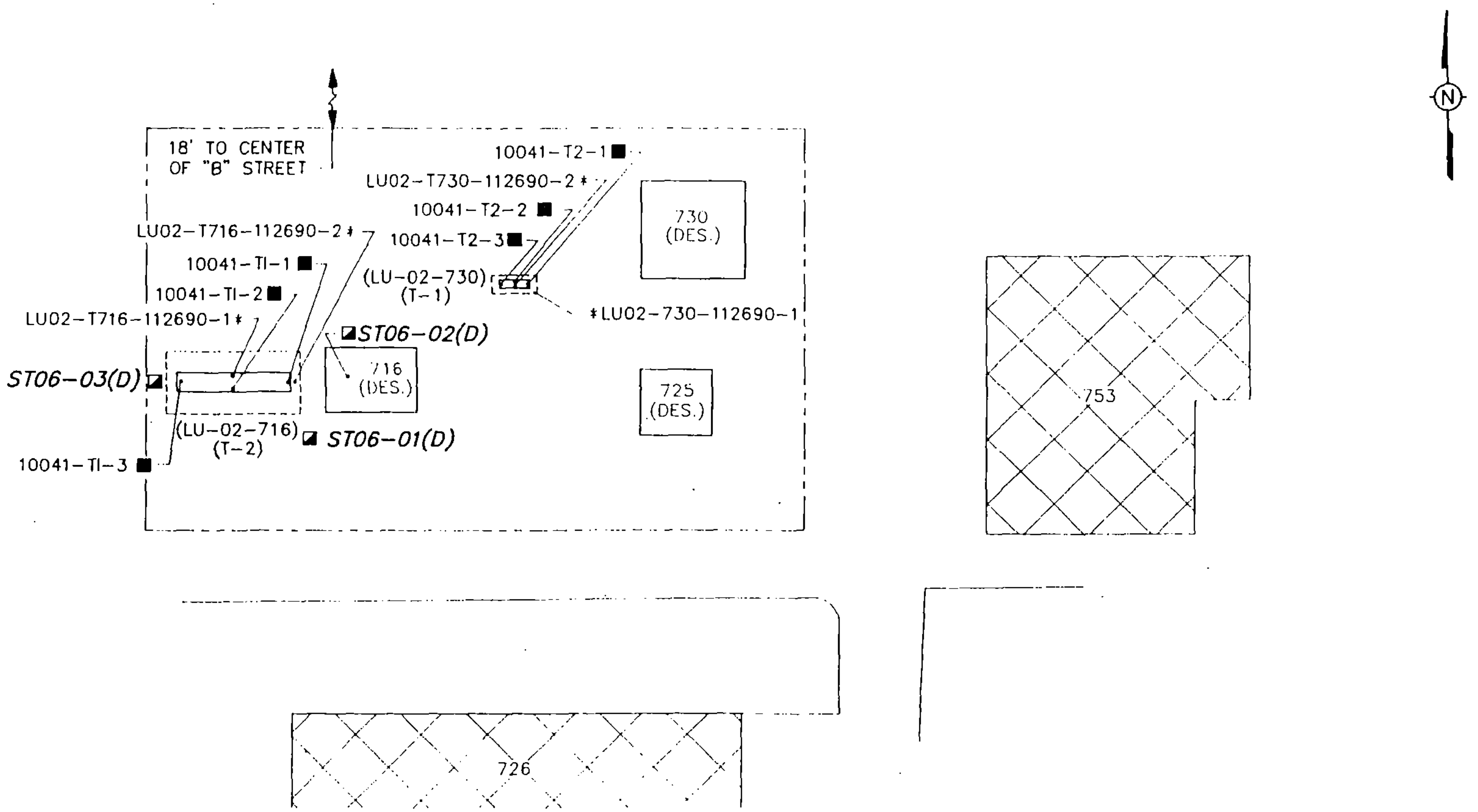
The results of 1989 soil sampling detected TPH, xylenes, benzoic acid, and benzyl alcohol in one sample.

The results of the soil samples collected in 1990 detected TPH, xylenes and 4-methylphenol at the Tank No. 1085-1 excavation. A sample collected from beneath the center of the concrete pad at Tank No. 1085-1, within 1 foot bls near the sump, contained various

Table 4–13
Underground Storage Tanks (ST–06) Soils – Organic Constitutents
Detected Constituents

Compound (mg/kg)	ST–06–03 [a] 8/90 –
Ethyl benzene	.880
Xylenes	1.480

Notes:
[a]8/90 to present – All data collected after 7/90 have been validated, and all the qualifiers are validation qualifiers.
J – Estimated value (less than the sample quantitation limit)
B – Analyte concentration is between the Instrument Detection Limit and the Contract Detection Limit
P – Indicates 25% difference for detected concentrations between the two GC columns.
HBFH – High Boiling Fuel Hydrocarbons



LEGEND:

753 (DES.) STRUCTURE/FACILITY NUMBER (DESTROYED)

IT SOIL BORING LOCATION (APPROXIMATE) AND NUMBER

LIMITS OF GEOPHYSICAL SURVEY

(T-1) APPROXIMATE LOCATION OF TANKHOLD BEFORE REMOVAL

APPROXIMATE LOCATION OF TANKHOLD EXCAVATION

IT SOIL SAMPLE LOCATION (APPROXIMATE)

EXCELTECH SOIL SAMPLE LOCATION (APPROXIMATE)

SCALE: 0 40 80 FEET

FIGURE 4-4
WILLIAMS AIR FORCE BASE
FORMER GAS STATION
BUILDING 725 (ST-06)
SOIL BORING/SOIL SAMPLE LOCATIONS

INTERNATIONAL TECHNOLOGY CORPORATION

DWG. NO.: 409735-E-64 | PROJ. NO.: 409735
INITIATOR: R. CLARK | PROJ. MGR.: W. CARTER
DRAFT. CHCK. BY: R. PITTS | ENGR. CHCK. BY: R. CLARK
DATE LAST REV.: 2/24/94 | DRAWN BY: J. TABLER
STARTING DATE: 06/25/92 | DRAWN BY: S. CARDWELL
40973564 02/24/94 2:32pm JAT

Table 4-14
Underground Storage Tanks (ST-07) Soils - Organic Constitutents
Detected Constituents

	Boring Number/Sample Location			
	Center of Tank 1086 Excavation	West of Tank 1086 Excavation	East of Tank 1086 Excavation	Boring 1086 Excavation
Compound (mg/kg)	[a] 8/90 -	8/90 -	8/90 -	8/90 -
Methylene Chloride	.012B	.013B	.01B	.007J-.037
TPH				30-1,130

WAFB\TABLES\ROD\4-12.WK3\lj\10-3-93

Notes:

[a]8/90 to present - All data collected after 7/90 have been validated, and all the qualifiers are validation qualifiers.

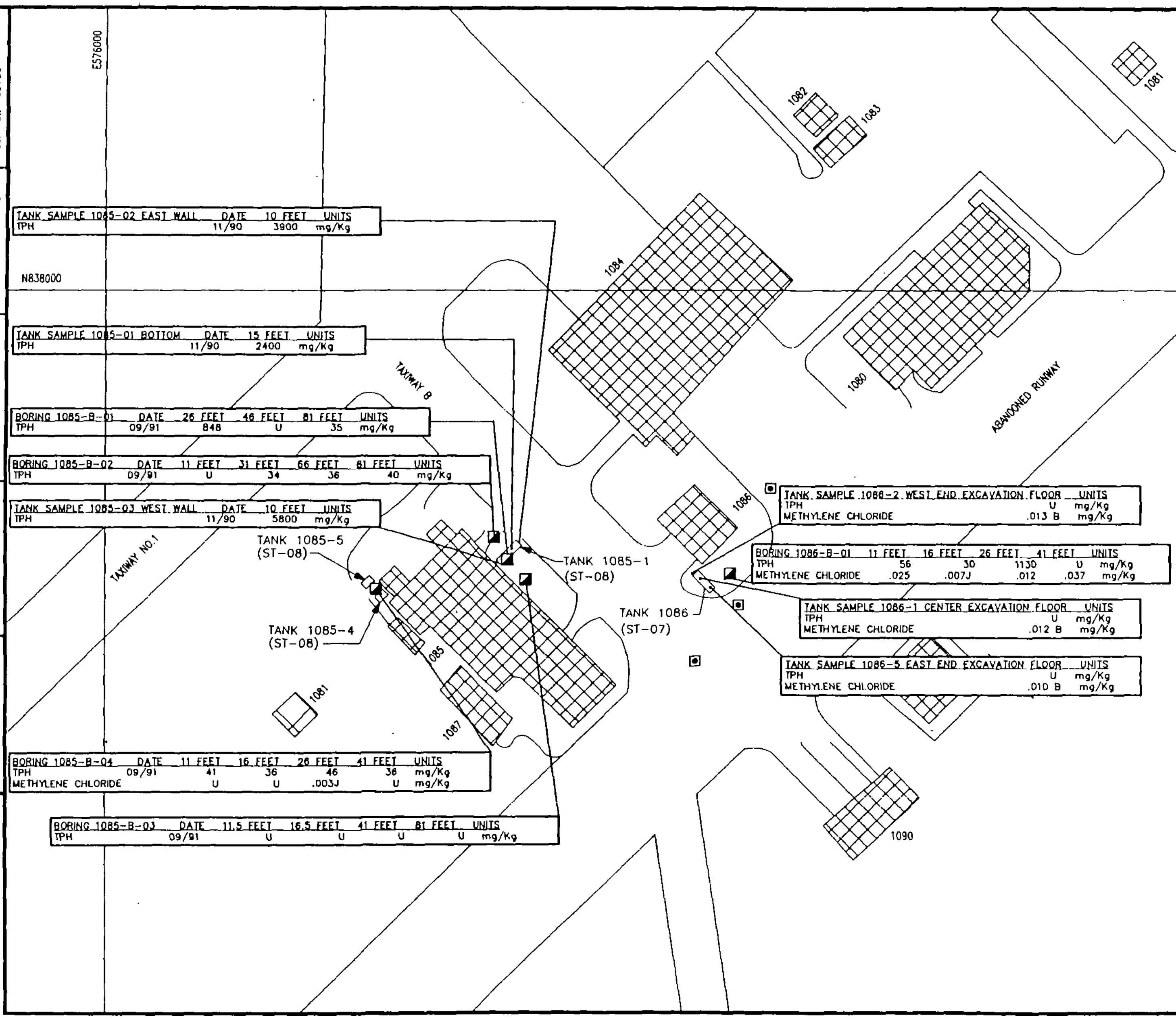
J - Estimated value (less than the sample quantitation limit)

B - Analyte concentration is between the Instrument Detection Limit and the Contract Detection Limit

P - Indicates 25% difference for detected concentrations between the two GC columns.

TPH - Total Petroleum Hydrocarbons

MEK - Methyl ethyl ketone, (2-butanone)



LEGEND:

- IT SOIL BORING LOCATION (APPROXIMATE)
- IT SOIL SAMPLE LOCATION (APPROXIMATE)
- (D) DENOTES DEEP BORING
- 1083 FACILITY NUMBER
- BUILDING
- (U) NONE DETECTED
- (B) ANALYTE IS FOUND IN THE ASSOCIATED BLANK AS WELL AS IN THE SAMPLE
- (J) ESTIMATED VALUE (LESS THAN SAMPLE QUANTITATION LIMIT)

NOTES:

1. SEE FIGURE 2-13 FOR SOIL BORING LOCATIONS
2. SEE FIGURE 2-14 FOR ST-07 TANK SAMPLE NUMBER LOCATIONS
3. SEE FIGURE 2-15 FOR ST-08 TANK SAMPLE NUMBER LOCATIONS (NUMBER 1085-1-280-112890-XX ARE SHOWN AS 1085-XX AND 1086-XX)

SCALE:

0 125 250 FEET

FIGURE 4-5

WILLIAMS AIR FORCE BASE BUILDINGS 1086 (ST-07) AND 1085 (ST-08) SELECTED CONSTITUENT CONCENTRATION MAP

INTERNATIONAL TECHNOLOGY CORPORATION

DWG. NO.: 409735-B-72 | PROJ. NO.: 409735
INITIATOR: R. CLARK | PROJ. MGR.: W. CARTER
DRAFT. CHCK. BY: R. PITTS | ENGR. CHCK. BY: R. CLARK
DATE LAST REV.: 2/24/94 | DRAWN BY: J. tabler
STARTING DATE: 06/25/92 | DRAWN BY: S. CARDWELL
3
40973572 02/25/94 2:35pm JWH

Table 4–15
Underground Storage Tanks (ST–08) Soils – Organic Compounds
Detected Constituents

	Boring Number/Sample Location										
	Tank 1085 Drainage at Southwest Corner	Tank 1085 Pad	1085–B–01	1085–B–02	1085–B–03	1085–B–04	1085	Bottom of 1085 Excavation	East Wall of Tank 1085 Excavation	West Wall of Tank 1085 Excavation	North Wall of Tank 1085 Excavation
Compound mg/L	*8/90 –	8/90 –	8/90 –	8/90 –	8/90 –	8/90 –	8/90 –	8/90 –	8/90 –	8/90 –	8/90 –
Semivolatile Organics											
4–Methylphenol									15		
Benzoic Acid							1.6J				
Benzo(a)anthracene		.680									
Benzo(a)pyrene		.370									
Benzo(b)fluoranthene		.430									
Benzo(k)fluoranthene		.570									
Benzyl Alcohol		.530					.310J				
Bis(2–ethylhexyl)phthalate	3.8	.700				.082J					
Chrysene		.650									
Diethylphthalate			.052J	.035J		.065J					
Di–n–butylphthalate						.047J					
Fluoranthene		1.3									
Phenanthrene		1.3									
Pyrene		1.2									
Acetone		.011B–.02	1.3J	.005J–.018	.008–.018						
Volatile Organics											
Methylene Chloride			.017B–.350BJ	.013B–.017B	.134B	.003J–.013B					.05B
PCE	.140		.003J–1.2J		.006J	.005J					.013
Xylenes			2.2				.011	2			
Other											
TPH	70	25	35–848	34–40		36–41	9–23	2,400	3,900	5,800	

WAFB\TABLES\ROD\4–13.WK3\j\10–3–93

Notes:
*8/90 to present – All data collected after 7/90 have been validated, and all the qualifiers are validation qualifiers.
J – Estimated value (less than the sample quantitation limit)
B – Analyte concentration is between the Instrument Detection Limit and the Contract Detection Limit
P – Indicates 25% difference for detected concentrations between the two GC columns.

409735 OU1 ROD

97350128 08/31/93 9:54am STC

STARTING DATE: 8/31/93	DATE LAST REV.:	DRAFT. CHCK. BY: R. PITTS	INITIATOR: W. ANDERSON	DWG. NO.: 409735-A-128
DRAWN BY: S. CARDWELL	DRAWN BY:	ENGR. CHCK BY: W. ANDERSON	PROJ. MGR.: W. CARTER	PROJ. NO.: 409735.30.22.001

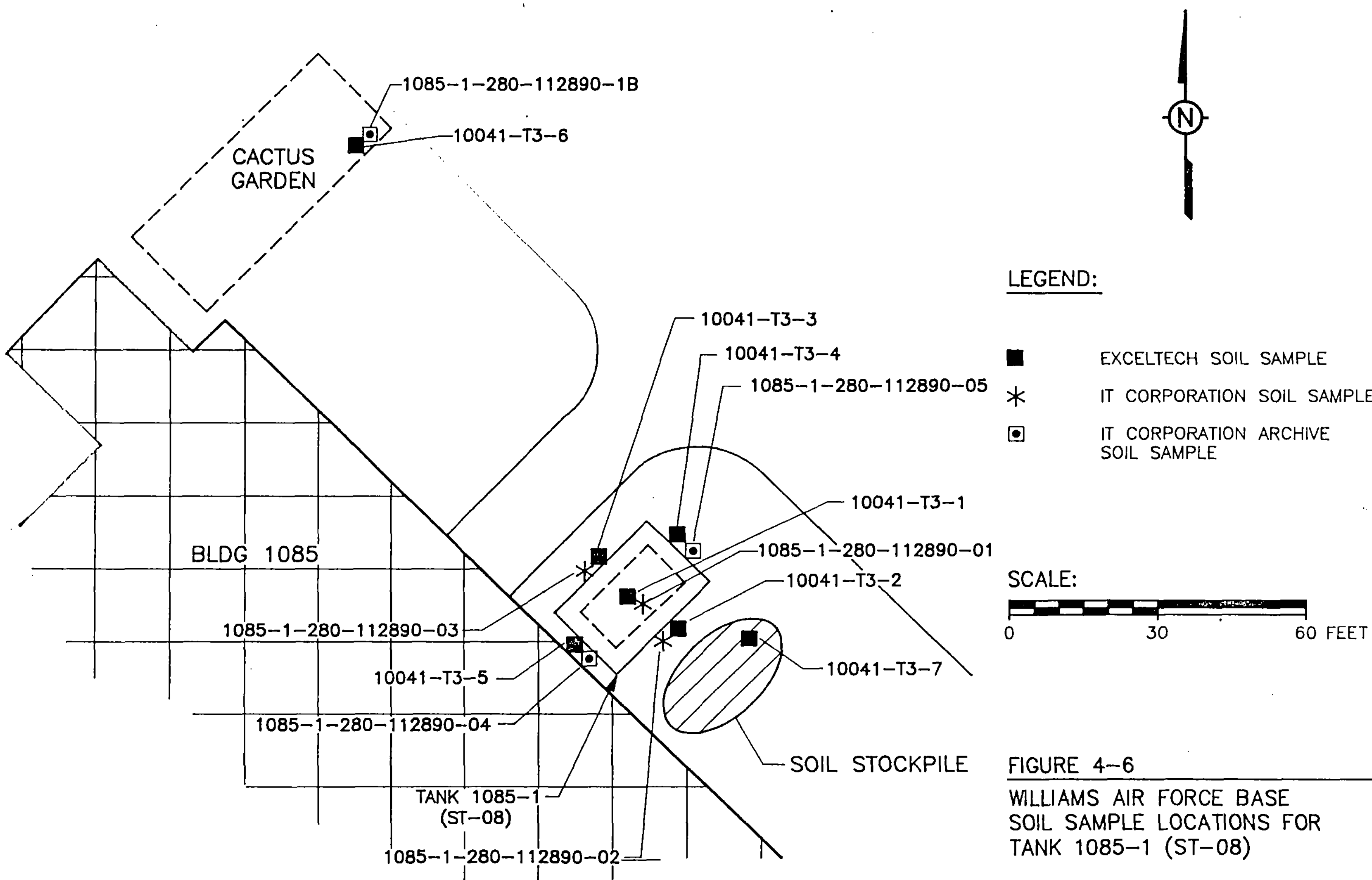


FIGURE 4-6

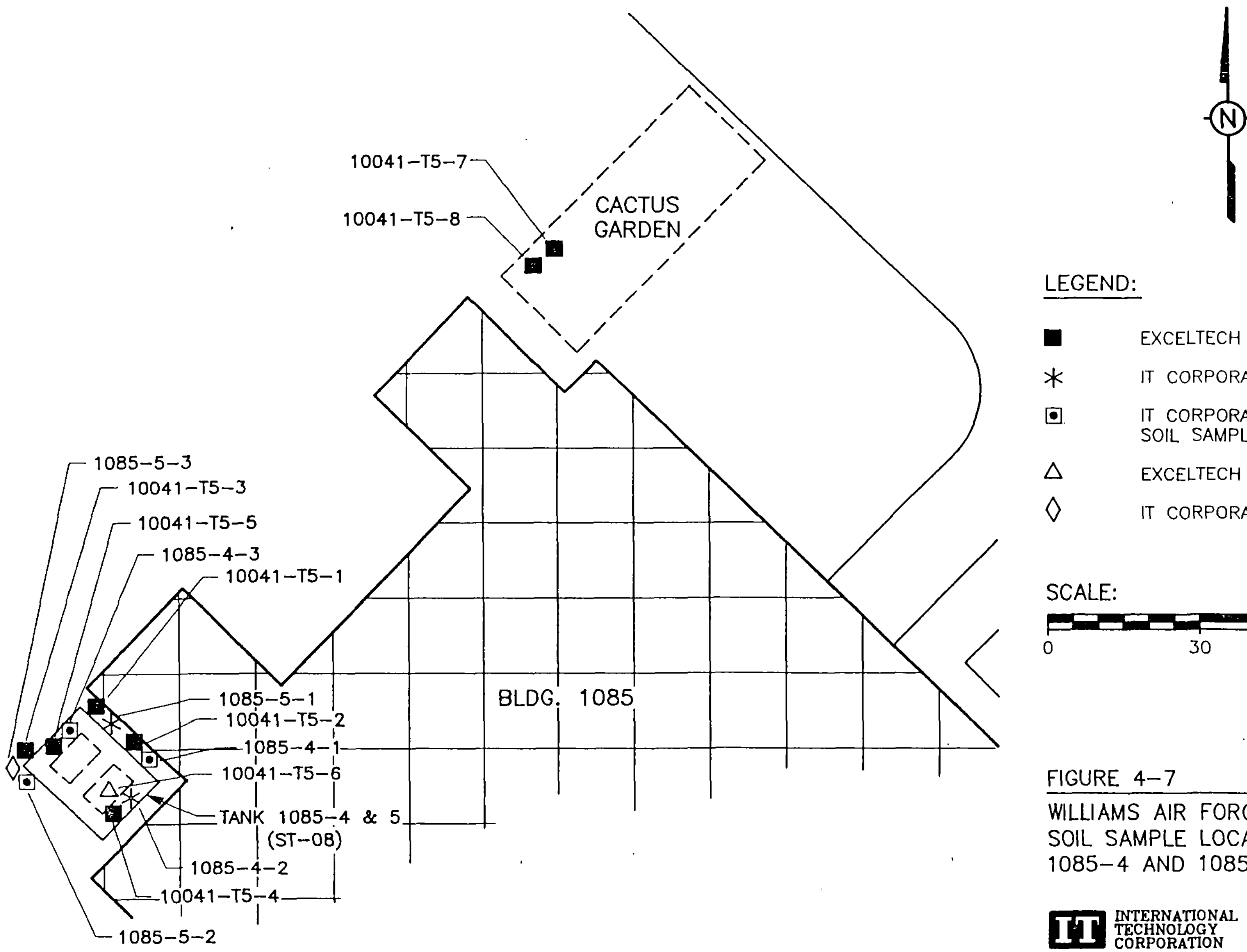
WILLIAMS AIR FORCE BASE
SOIL SAMPLE LOCATIONS FOR
TANK 1085-1 (ST-08)

INTERNATIONAL TECHNOLOGY CORPORATION

409735 OU1 ROD

97350129 08/31/93 9:46am STC

STARTING DATE: 8/31/93	DATE LAST REV.:	DRAFT. CHCK. BY: R. PITTS	INITIATOR: W. ANDERSON	DWG. NO.: 409735-A-129
DRAWN BY: S. CARDWELL	DRAWN BY:	ENGR. CHCK BY: W. ANDERSON	PROJ. MGR.: W. CARTER	PROJ. NO.: 409735.30.22.001



LEGEND:

- ■ EXCELTECH SOIL SAMPLE
- ✱ IT CORPORATION SOIL SAMPLE
- ⊡ IT CORPORATION ARCHIVE SOIL SAMPLE
- △ EXCELTECH CONCRETE SAMPLE
- ◊ IT CORPORATION SLUDGE SAMPLE

SCALE:

0 30 60 FEET

FIGURE 4-7

WILLIAMS AIR FORCE BASE
SOIL SAMPLE LOCATIONS FOR TANKS
1085-4 AND 1085-5 (ST-08)

INTERNATIONAL TECHNOLOGY CORPORATION

polynuclear aromatic hydrocarbons (PAH). These constituents were not detected in any other sample and indicate an area of very localized contamination. Samples taken under the south, north, and west ends of the pad at Tank No. 1085-1 contained bis(2-ethylhexyl) phthalate and benzyl alcohol. Methylene chloride, tetrachloroethene (PCE), bis(2-ethylhexyl) phthalate, and TPH were detected in the vicinity of the Tank No. 1085-5 excavation.

The analytical results of the samples taken in 1991 reveal the following. Samples taken from borings at Tank No. 1085-01 detected four VOCs and one SVOC. Contaminants were detected at a maximum depth of 81 feet bls. Samples taken from the boring at Tank No. 1085-04 had detected levels of two VOCs and three SVOCs. Contaminants were detected down to 41 feet bls. The lateral extent of contamination is shown in Figure 4-5.

Detected inorganic constituents are presented in Table 4-16. Antimony was the only metal in surface soil samples collected during 1989 that was detected above regional background levels.

Soil samples were also collected and analyzed for TCLP parameters from the tankhold during 1990 and the later 1991 boring investigation. These data are presented in Table 4-17. No sample exceeded RCRA regulatory levels.

Groundwater at this site was not monitored because there was no indication or evidence of a pathway to groundwater from the suspect soils.

4.2 Contaminant Fate and Transport

Contaminant fate and transport was addressed in the OU-1 RI report, Chapter 5.0. A brief synopsis is presented in the following sections.

4.2.1 Contaminant Persistence in the Environment

Chemical persistence in environmental media is determined by the chemical's ability to move through a medium, to transfer from one medium to another, and to transform or degrade. These determinants are in turn controlled by the characteristics of the chemicals (i.e., solubility, Henry's law constant, and affinity for organic and inorganic surfaces) and of the environmental medium (i.e., mineralogy, organic carbon content and porosity of the soil, and temperature and salinity of groundwater). The migration and decay potential for various compounds found in the soil/groundwater system is discussed in the following paragraphs.

Table 4-16
Underground Storage Tanks (ST-08) Soils - Inorganic Constitutents
Detected Constituents [a]

Compound (mg/kg)	Sample Location/Boring Number		
	Tank 1085	Tank 1085 Drainpipe at Southwest Corner	Tank 1085 PAD
	[b]1/87 to 7/90	[c] 8/90 -	8/90 -
Antimony	15-31		
Cadmium	2		
Chromium	18-41		
Copper	13-21		
Cyanide		2.6	0.82-1.1
Lead	10-30		
Nickel	10-30		
Zinc	32-85		

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Notes:

[a] - the data presented is divided into collection times from 1/87 to 7/90 and 8/90 on to facilitate analysis of data that was not validated (collected from 1/87 to 7/90) and data that has been validated (collected from 8/90 on)

[b] 1/87 to 7/90 - All data collected in this time period are nonvalidated data, and all the qualifiers are laboratory qualifiers.

[c]8/90 to present - All data collected after 7/90 have been validated, and all the qualifiers are validation qualifiers.

J - Estimated value (less than the sample quantitation limit)

B - Analyte concentration is between the Instrument Detection Limit and the Contract Detection Limit

P - Indicates 25% difference for detected concentrations between the two GC columns.

TPH - Total Petroleum Hydrocarbons

MEK - Methyl ethyl ketone, (2-butanone)

Table 4-17
Underground Storage Tanks (ST-08) Soils - TCLP Inorganic Constituents
Detected Constituents

Compound (mg/L)	Sample Location/Boring Number			
	Bottom of Tank 1085 Excavation	East Wall of Tank 1085 Excavation	Bottom of Tank 1085-4 Excavation	North Wall of Tank 1085 Excavation
	[a]8/90 -	8/90 -	8/90 -	8/90 -
Barium	1	1.2	0.6	0.8
Cadmium				0.13
Chromium			0.03	0.18
Lead				

Compound (mg/L)	Sample Location/Boring Number				
	1085-B-01	1085-B-04	1085-B-02	1085-B-03	Tank 1085-PAD
	8/90 -	8/90 -	8/90 -	8/90 -	8/90 -
Barium	0.325-1.17	0.339-0.506	0.184-0.918	0.49-1.12	0.4-0.8
Cadmium		0.0056		0.0036B	0.28-0.89
Chromium	0.0054B	0.011-0.0671			0.22-1.3
Lead		0.103B			

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Notes:
[a]8/90 to present - All data collected after 7/90 have been validated, and all the qualifiers are validation qualifiers.
J - Estimated value (less than the sample quantitation limit)
B - Analyte concentration is between the Instrument Detection Limit and the Contract Detection Limit
P - Indicates 25% difference for detected concentrations between the two GC columns.
TPH - Total Petroleum Hydrocarbons
MEK - Methyl ethyl ketone, (2-butanone)

Chemicals in soil may migrate to groundwater via water infiltration, dispersion, and diffusion. Migration of chemicals from soil to groundwater is generally reduced by high organic content in the soil, lower temperatures, and lower organic content and higher salinity in the soil-water compartment. The fraction of a chemical present in the soil-groundwater and soil-air compartments is generally more mobile than the fraction adsorbed to soil. Many chemicals, both organic and inorganic, tend to adsorb more readily in top soil than at depth because the organic carbon content is generally lower in deep soils.

Volatile organic chemicals in the soil, especially in the soil-air compartment or in the soil near the surface, can migrate via diffusion through soil-air pore spaces to the ground surface, where they are transported by wind. Migration of chemicals from soil to air is controlled by the volatility and mobility of the chemical. Chemicals with high volatility but low mobility, because of high soil adsorption, will not migrate significantly to air. Similarly, chemicals with high mobility but low volatility will not partition significantly to air. The volatility of a compound may be inferred from its Henry's law constant (H). As H increases, the volatility of a compound increases. The capacity for an organic chemical to adsorb in soils may be inferred from its organic carbon partition coefficient (K_{oc}). A high K_{oc} indicates a high adsorption potential. The H, K_{oc}, K_{ow} (a measure of the chemicals affinity for organic solvents versus water), and water solubility for chemicals found in the soil and groundwater at OU-1 are listed in Table 4-18.

Chemicals in the environment may decay through chemically or biologically mediated processes. The primary chemical decay processes in the soil-groundwater system are hydrolysis and oxidation/reduction. Vapor-phase chemicals may degrade by photolysis and photochemical oxidation. Organic chemicals in soil and groundwater may also be degraded by aerobic and/or anaerobic bacteria. This degradation is affected by nutrient levels, temperature, chemical concentration, and the density of degrading organisms. The following discussion attempts to describe the persistence and behavior of target classes of compounds via these processes. A detailed discussion of contaminant fate and transport at OU-1 is provided in the OU-1 RI/FS reports.

Table 4-18

Chemical Parameters Affecting Environmental Transport and Persistence
Williams Air Force Base

Compound	Log K_{ow}[a] (unitless)	K_{oc}[a] (unitless)	H[a] ($atm\text{-}m^3/mol$)	Water Solubility[a] (mg/L)
Acetone	-0.24	0.28	397×10^{-5}	Infinitely Soluble
Benzene	2.13	65	5.43×10^{-3}	1,780
Bis(2-ethylhexyl)phthalate	3.98	62,000	2.50×10^{-7}	0.4
Bromodichloromethane	1.44	120	1.22×10^{-3}	9,000
Chloroform	1.97	44	3.75×10^{-3}	8,220
Dieldrin	3.50	1700	4.58×10^{-7}	0.195
4,4'-DDT	6.19	243,000	5.1×10^{-4}	5×10^{-3}
Di-n-butylphthalate	4.9[b]	160; 6,400[b]	5.3×10^{-5}[b]	13[b]
1,2-Dichlorobenzene	3.38	1,160	1.88×10^{-3}	156
1,3-Dichlorobenzene	3.60	1,920	3.55×10^{-3}	123
1,4-Dichlorobenzene	3.39	1,180	1.58×10^{-3}	87
Ethyl benzene	3.15	682	7.90×10^{-3}	152
Methylene chloride	1.25	8.8	2.57×10^{-3}	13,200
Methyl ethyl ketone (2-Butanone)	0.29	0.94	4.35×10^{-5}	353,000
Phenol	1.46	14,135	7.00×10^{-7}	84,000
Pyrene	4.88	38,000	5.04×10^{-6}	0.13
Tetrachlorethene	3.14[c]	665[c]	2.27×10^{-2}[c]	150[c]
Toluene	2.73	2.59	6.61×10^{-3}	515
Xylenes	3.16[b]	58[b]	2.90×10^{-1}[b]	Nearly Insoluble

[a]Unless otherwise noted, all data are from ORNL, 1989.
[b]From NLM, 1991.
[c]From Arthur D. Little, 1985.

4.2.2 Site-Specific Applicability

4.2.2.1 Landfill (LF-04)

A simplistic transport model was constructed to provide an estimate of contamination infiltration to the groundwater at LF-04. This model was developed initially for ST-12 at which benzene is a primary contaminant. Although benzene is not a contaminant at LF-04, the model provides indications of length of time for a contaminant to migrate to the aquifer and levels of contaminant once it reaches groundwater. Details of the calculations are found in Appendix F of the OU-1 FS report.

Contaminant transport was first modeled by calculating the time period required for water to migrate from the ground surface to the water table, assuming saturated flow. Groundwater contaminant concentrations due to transport from soils were then calculated using the Summers et al. model (1980).

Based on a vertical flow to the water table at 200 feet below grade and a hydraulic gradient of 1 vertical foot per horizontal foot, the time required for water to complete the flow path is 66.5 years. Based on modeling using benzene as previously noted, it was determined that the concentration of this chemical in groundwater would be three to four orders of magnitude less than the concentration in surface soil. The ratio of K_{oc}s for dieldrin and benzene (1700/65) shows that dieldrin partitions more strongly toward the soil and its rate of migration to groundwater would be much slower than benzene. Also, the solubility of dieldrin in water is approximately 4 orders of magnitude less than benzene. Therefore, the migration of dieldrin from surface soils to groundwater is not a practical concern.

Beryllium concentrations in site groundwater were also modeled using the Summers et al. equations. Assuming a beryllium concentration in soil of 2.8 mg/kg, the model predicts levels of beryllium in the groundwater from 0.3 to 3.46 micrograms per liter (µg/L).

4.2.2.2 Fire Protection Training Area 1 (FT-03)

FT-03 does not require fate and transport analysis due to the absence of chemicals of potential concern that pose risk to human health and the environment and/or that are present above risk-based levels requiring remedial action. The contaminants detected at this site are also generally immobile in soils.

4.2.2.3 Northwest Drainage System (SD-10)
SD-10 does not require fate and transport analysis due to the absence of chemicals of potential concern that pose risk to human health and the environment and/or that are present above risk-based levels requiring remedial action. The contaminants detected at this site are also generally immobile in soils.

4.2.2.4 Radioactive Instrumentation Burial Area (RW-11)
Fate and transport analysis is not required for RW-11 due to the lack of radiological constituents present above background levels or that pose risk to human health or the environment. Potential contaminants have also been removed.

4.2.2.5 Pesticide Burial Area (DP-13)
Fate and transport analysis is not required for DP-13 because the contaminants that pose risk to human health and the environment at this site have been removed.

4.2.2.6 Hazardous Materials Storage Area (SS-01)
SS-01 does not warrant fate and transport analysis due to the absence of chemicals of potential concern that pose risk to human health and the environment and/or that are present above risk-based levels requiring remediation. The contaminants detected at this site are also generally immobile in soils.

4.2.2.7 USTs at Building 789 (ST-05)
Fate and transport analysis are not required for ST-05 due to the absence of chemicals of potential concern that pose risk to human health and the environment and/or that are present above risk-based levels requiring remediation.

4.2.2.8 USTs at Building 725 (ST-06)
Fate and transport analysis are not required for ST-06 due to the absence of chemicals of potential concern that pose risk to human health and the environment and/or that are present above risk-based levels requiring remediation.

4.2.2.9 USTs at Building 1086 (ST-07)
Fate and transport analysis is not required for ST-07 due to the lack of driving force to transport the chemicals of potential concern to groundwater. There was a removal action at this site. The concentration levels of contaminants not removed are too low to migrate to groundwater and too deep for the completion of a pathway to receptors.

4.2.2.10 USTs at Building 1085 (ST-08)

Fate and transport analysis is not required for ST-08 due to the lack of driving force to transport the chemicals of potential concern to groundwater. There was a removal action at this site. The concentration levels of contaminants not removed are too low to migrate to groundwater and too deep for the completion of a pathway to receptors.

5.0 Summary of Potential Site Risks

5.1 Chemicals of Potential Concern

The risk assessment identified the chemicals of potential concern at OU-1. This identification process included summarizing the analytical data for OU-1 and evaluating the data according to EPA guidelines for CERCLA risk assessments (EPA, 1989a). Chemicals of potential concern were selected from the list of all detected constituents based on the following criteria:

- Frequency of detection - if chemicals were detected at greater than 5 percent frequency

- Comparison to method blanks - if sample concentrations exceeded laboratory blank concentrations by 10 times for common laboratory contaminants and 5 times for all other analytes

- Comparison to background - if the range of concentrations from OU-1 samples exceeded background values.

This evaluation and selection process is discussed in greater detail in the OU-1 RI report, Section 6.2. All organic chemicals and metals selected as chemicals of potential concern were carried forward through the risk assessment calculations.

The following sections present chemicals of potential concern by site for soils and groundwater.

5.1.1 Chemicals of Potential Concern for Soils

5.1.1.1 Landfill (LF-04)

Chemicals detected in soil samples from LF-04 are listed in Table 5-1. The following chemicals were not selected as chemicals of potential concern for the reasons indicated:

- Acenaphthene was detected in less than 5 percent of the surface soil samples.

- Arsenic, benzo(a)pyrene, chromium, chrysene, copper, lead, nickel, pyrene, and selenium were each detected at concentrations within the range of background for the area.

The remaining 17 chemicals listed in Table 5-1 are the chemicals of potential concern for surface soil in LF-04.

Table 5-1

Analytical Data Summary
Landfill (LF-04) Surface Soils
Williams Air Force Base

(Page 1 of 2)

Analyte	Frequency of Detection[a]	Value or Range of Detection Limits (mg/kg)	Value or Range of Detected Concentrations (mg/kg)	Range of Background[b] (mg/kg)	Upper 95% Concentration[c] (mg/kg)
Organics					
*1,2,4-Trichlorobenzene	1/10	0.33-3.5	0.037	NA	0.679
*1,4-Dichlorobenzene	2/10	0.33-3.5	0.035-0.08	NA	0.673
*4,4'-DDD	4/10	0.0035-0.014	0.0037-0.013	NA	0.0072
*4,4'-DDE	9/10	0.0035-0.014	0.0021-0.1	NA	0.064
*4,4'-DDT	8/10	0.0035-0.014	0.006-0.098	NA	0.067
Acenaphthene	1/20	0.33-3.5	0.038	NA	0.554
*Alpha-chlordane	1/10	0.0018-0.0072	0.0017	NA	0.0025
Benzo(a)pyrene	1/10	0.35-3.5	0.034	0.0046-0.9	0.68
*Beta-BHC	4/10	0.0018-0.0072	0.0016-0.008	NA	0.0041
*Bis(2-ethylhexyl)phthalate	9/10	0.35-3.5	0.021-0.2	NA	0.613
Chrysene	1/10	0.35-3.5	0.022	0.078-0.64	0.68
*Di-n-butyl phthalate	2/10	0.35-3.5	0.026-0.033	NA	0.67
*Dieldrin	8/10	0.0035-0.014	0.0045-0.25	NA	0.105
*Diethyl phthalate	1/10	0.35-3.5	0.037	NA	0.68
*Gamma-chlordane	1/10	0.0018-0.0072	0.0016	NA	0.0025

Table 5-1

Analyte	Frequency of Detection[a]	Value or Range of Detection Limits (mg/kg)	Value or Range of Detected Concentrations (mg/kg)	Range of Background[b] (mg/kg)	Upper 95% Concentration[c] (mg/kg)
Organics (Continued)					
*Pentachlorophenol	1/10	0.85-8.5	0.31	NA	1.666
Pyrene	1/10	0.35-3.5	0.044	0.099-147	0.681
Inorganics					
Arsenic	10/10	2.0	1.8-6.4	2-97	5.2
*Beryllium	10/10	1.0	1.8-3.8	1.0-1.5	2.8
*Cadmium	1/10	0.83-1.0	1.7	NA	0.84
Chromium	10/10	2.0	17-28	15-100	23
Copper	10/10	5.0	21-57	15-200	42
Lead	10/10	0.6	13-117	10-100	54
Nickel	10/10	8.0	12-29	7-50	22
Selenium	1/10	0.2-1.0	0.21	<0.1-0.8	0.14
*Thallium	6/10	0.2-2.0	0.23-0.36	NA	0.285
*Zinc	10/10	4.0	49-203	25-150	116

*Chemical of potential concern.
NA=not available or not used for comparison.
[a]x/y where x = number of times detected and y = number of samples analyzed.
[b]PAH background in agricultural and urban surface soils in the U.S. and other countries, ATSDR, 1989. Metals background from Boerngen and Shacklette, 1981.
[c]IT, 1992b - calculations include nondetects at half the contract-required detection limit.

5.1.1.2 Fire Protection Training Area (FT-03)

Soil samples taken at verified site locations associated with FT-03 disclosed no potentially hazardous contaminants at concentrations that would cause concern. Therefore, this site was not addressed in the risk assessment.

5.1.1.3 Northwest Drainage System (SD-10)

Chemicals detected in soil samples from SD-10 are listed in Table 5-2. The following chemicals were not selected as chemicals of potential concern for the reasons indicated:

- 1,1,1,2-Tetrachloroethane, 1,3-dichlorobenzene, benzo(a)anthracene, and trichloroethene were each detected in 5 percent or less of the soil samples.

- Arsenic, chromium, copper, lead, mercury, nickel, and zinc were each detected within the range of background for the area.

The remaining 10 chemicals listed in Table 5-2 are the chemicals of potential concern for soil in SD-10.

5.1.1.4 Radioactive Instrumentation Burial Area (RW-11)

Radioactive chemicals detected at RW-11 were not considered chemicals of potential concern because their concentrations were within background concentrations for Arizona surface soils (Myrick, et al., 1983). As listed in Table 5-3, radium-226, radium-228, and total uranium were each detected within background levels for the area. Neither gross alpha nor gross beta were considered as chemicals of potential concern because these analyses are not specific to any particular radionuclide.

5.1.1.5 Pesticide Burial Area (DP-13)

Chemicals detected in soil samples from DP-13 are listed in Table 5-4. The following chemicals were not selected as chemicals of potential concern for the reasons indicated:

- 4,4'-dichlorodiphenyldichloroethylene (DDE), 4,4'-dichlorodiphenyltrichloroethane (DDT), 2-butanone, bromodichloromethane, benzo(b)fluoranthene, chrysene, di-n-butyl phthalate, dieldrin, gamma-beta-hexachlorobenzene (BHC), pyrene, and xylenes were each detected in 5 percent or less of the soil samples.

- Arsenic, beryllium, chromium, copper, lead, nickel, and zinc were each detected at concentrations within the range of background for the area.

Table 5-2

Analytical Data Summary
Northwest Drainage System (SD-10) Soils
Williams Air Force Base

Analyte	Frequency of Detection[a]	Value or Range of Detection Limits (mg/kg)	Value or Range of Detected Concentrations (mg/kg)	Range of Background[b] (mg/kg)	Upper 95% Concentration[c] (mg/kg)
Organics					
1,1,1,2-Tetrachloroethane	1/50	0.005-1.0	1.0	NA	0.44
1,3-Dichlorobenzene	1/122	0.001-1.0	24.0	NA	0.906
*Acetone	14/14	0.01	0.003-0.053	NA	0.018
Benzo(a)anthracene	1/73	0.001-0.73	0.11	NA	0.071
*Bis(2-ethylhexyl)phthalate	12/14	0.34-0.73	0.53-12.0	NA	5.89
Di-n-octylphthalate	1/50	0.02-0.73	0.13	NA	0.11
Butylbenzyl phthalate	1/50	0.003-0.73	0.063	NA	0.13
Chlorobenzene	1/86	0.005-1.0	6.0	NA	0.62
*Chloroform	10/50	0.005-1.0	0.001-2.0	NA	0.74
Chlorotoluene	1/36	2.0	24.0	NA	2.9
Chrysene	1/50	0.001-0.73	0.18	0.078-0.64	0.1
*Methylene chloride	25/50	0.005-1.0	.003-4.0	NA	1.38
Fluoranthene	1/49	0.003-0.73	0.16	NA	0.13
*Phenol	9/50	0.001-0.73	0.092-0.82	NA	0.171
Tetrachloroethene	1/50	0.005-1.0	1.0	NA	0.44
*Toluene	4/50	0.005-2.0	0.001-0.002	NA	0.85

Table 5-2

(Page 2 of 2)

Analyte	Frequency of Detection[a]	Value or Range of Detection Limits (mg/kg)	Value or Range of Detected Concentrations (mg/kg)	Range of Background[b] (mg/kg)	Upper 95% Concentration[c] (mg/kg)
Trichloroethene	2/50	0.005-1.0	0.001-2.0	NA	0.5
Inorganics					
*Antimony	5/50	1.0-1.5	14-34	<1	6.1
Arsenic	7/50	2.0-3.0	2.0-5.0	2-97	1.7
*Beryllium	35/50	0.01-2.0	0.25-1.8	1.0-1.5	0.95
*Cadmium	3/50	0.4-2.0	1.0-1.5	NA	0.61
Chromium	50/50	0.7-2.0	5.0-42	15-100	20.5
Copper	51/51	0.6-5.0	6-510	15-200	61.0
Lead	55/57	1.0-4.0	2.0-67	10-100	19
Mercury	2/49	0.1-0.2	0.2	0.01-0.48	0.08
Nickel	46/50	2.0-11	1.0-34	7-50	16
*Silver	18/50	0.7-3.0	0.9-4.1	NA	1.3
Zinc	51/51	0.2-4.0	27-440	25-150	85.21

*Chemical of potential concern.
NA = Not available or not used for comparison.
[a]x/y where x = number of times detected and y = number of samples analyzed.
[b]PAH background in agricultural and urban surface soils in the U.S. and other countries, ATSDR, 1989. Metals background from Boerngen and Shacklette, 1981.
[c]IT, 1992b - calculations include nondetects at half the contract-required detection limit.

The remaining five chemicals listed in Table 5-4 are the chemicals of potential concern for soil at DP-13.

5.1.1.6 Hazardous Materials Storage Area (SS-01)

Chemicals detected in soil samples from SS-01 are listed in Table 5-5. Some chemicals were not selected as chemicals of potential concern for the following reasons:

- 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, chlorobenzene, chloroform, and toluene were detected in 5 percent or less of the soil samples.

- Arsenic, chromium, lead, mercury, nickel, and zinc were each detected at concentrations within the range of background for the area.

The remaining ten chemicals listed in Table 5-5 are the chemicals of potential concern for soil at SS-01.

5.1.1.7 USTs at Building 789 (ST-05)

Chemicals detected in soil samples from ST-05 are listed in Table 5-6. Each chemical detected within ST-05 is considered a chemical of potential concern.

5.1.1.8 USTs at Building 725 (ST-06)

Chemicals detected in soil samples from ST-06 are listed in Table 5-7. Each chemical detected within ST-06 is considered a chemical of potential concern.

5.1.1.9 USTs at Building 1086 (ST-07)

As listed in Table 5-8, methylene chloride was the only chemical detected and is the only chemical of potential concern at ST-07.

5.1.1.10 USTs at Building 1085 (ST-08)

Chemicals detected in soil samples from ST-08 are listed in Table 5-9. The following chemicals were not selected as chemicals of potential concern for the reasons indicated:

- Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, fluoranthene, and pyrene were detected at concentrations within the range of background for the area.

- Chromium, copper, lead, nickel, and zinc were each detected at concentrations within the normal background for the area.

The remaining 15 chemicals listed in Table 5-9 are the chemicals of potential concern for soil in ST-08.

Table 5-3

Analytical Data Summary
Radioactive Instrument Burial Area (RW-11) Soils
Williams Air Force Base

Analyte	Frequency of Detection	Range of Detection Limits[a]	Range of Detected Concentrations[a]	Background Range[a,b]	Average Conc.[a]	Upper 95% Concentration[a]
Radium-226	15/15	0.05	0.77-2.3	0.23-2.0	1.51	1.84
Radium-228	6/6	--[c]	1.03-1.3	0.20-1.3	1.18	1.28
Total Uranium	15/15	0.1	0.4-1.45	0.54-3.6	0.97	1.14
Gross Alpha	15/15	0.3	2.8-27	NA	11.26	16.25
Gross Beta	15/15	0.1	4.3-27	NA	12.83	17.91

NA - Not available or not used for comparison
[a]All concentrations in pCi/g
[b]From Myrick et al., 1981; background concentrations for Arizona surface soils
[c]Detection limits not reported

Table 5-4

Analytical Data Summary
Pesticide Burial Area (DP-13) Soils
Williams Air Force Base

Analyte	Frequency of Detection[a]	Value or Range of Detection Limits (mg/kg)	Value or Range of Detected Concentrations (mg/kg)	Range of Background[b] (mg/kg)	Upper 95% Concentration[c] (mg/kg)
Volatile Organics					
2-Butanone	1/25	0.01-0.012	0.002	NA	0.0055
*Acetone	6/25	0.01-0.12	0.006-0.18	NA	0.027
Bromodichloromethane	1/25	0.005-0.006	0.039	NA	0.007
*Toluene	3/25	0.005-0.006	0.002-0.006	NA	0.003
Xylenes	1/25	0.005-0.006	0.002	NA	0.0026
Semivolatile Organics					
Benzo(b)fluoranthene	1/25[d]	0.33-5.6	0.079[d]	0.058-62.0	0.664
*Bis(2-ethylhexyl)phthalate	9/25	0.33-5.6	0.038-65.0	NA	14.17
Chrysene	1/25[d]	0.33-5.6	0.039[d]	0.078-0.64	0.663
Di-n-butyl phthalate	1/25	0.33-5.6	0.14	NA	0.665
*Phenol	3/25	0.33-5.6	0.082-0.61	NA	0.676
Pyrene	1/25[d]	0.33-5.6	0.045[d]	0.099-147.0	0.663
Pesticides, PCBs					
4,4'-DDE	3/60	0.001-0.02	0.014-0.018	NA	0.0057
4,4'-DDT	1/60	0.001-0.02	0.024	NA	0.0056
Dieldrin	3/60	0.001-0.02	0.016-0.52	NA	0.03
Gamma-BHC (Lindane)	1/60	0.001-0.00175	0.019	NA	0.0033

Table 5-4

(Page 2 of 2)

Analyte	Frequency of Detection[a]	Value or Range of Detection Limits (mg/kg)	Value or Range of Detected Concentrations (mg/kg)	Range of Background[b] (mg/kg)	Upper 95% Concentration[c] (mg/kg)
Inorganics					
*Antimony	5/7	12-20	20-52	<1	41
Arsenic	4/8	0.01-3.0	2.0-4.0	2-97	39
Beryllium	1/7	1.0-2.0	1.0	1.0-1.5	1.0
Chromium	7/8	2.0-5.0	5.0-18	15-100	20
Copper	7/7	5.0	19-63	15-200	48
Lead	7/8	1.0-200	8.0-22	10-100	49
Nickel	6/7	8.0-21	8.0-21	7-50	18
Zinc	7/7	4.0	42-72	25-150	68

*Chemical of potential concern.
NA=not available or not used for comparison.
[a]x/y where x = number of times detected and y = number of samples analyzed.
[b]PAH background in agricultural and urban surface soils in the U.S. and other countries, ATSDR, 1989. Metals background from Boerngen and Shacklette, 1981.
[c]IT, 1992b - calculations include nondetects at half the contract-required detection limit.
[d]Detected in a surface soil sample

Table 5-5

Analytical Data Summary
Hazardous Materials Storage Area (SS-01) Soils
Williams Air Force Base

(Page 1 of 2)

Analyte	Frequency of Detection[a]	Value or Range of Detection Limits (mg/kg)	Value or Range of Detected Concentrations (mg/kg)	Background Concentrations[b] (mg/kg)	Upper 95% Concentration[c] (mg/kg)
Organics					
*Acetone	4/17	0.01-0.012	0.002-0.009	NA	0.0065
Chlorobenzene	1/101	0.01-1.0	3.0	NA	0.504
Chloroform	2/59	0.01-1.0	3.0-4.0	NA	0.622
*Ethyl benzene	5/59	0.01-1.0	2.0-4.0	NA	0.691
*Methylene chloride	8/59	0.01-1.0	3.0-21.0	NA	2.819
Toluene	1/59	0.01-2.0	2.0	NA	0.856
*Xylenes	6/59	0.01-2.0	3.0-12.0	NA	1.548
1,2-Dichlorobenzene	4/101	0.002-2.738	4.0-10.0	NA	0.864
1,3-Dichlorobenzene	2/143	0.001-1.369	3.0-6.0	NA	0.475
1,4-Dichlorobenzene	5/101	0.001-1.369	2.0-8.0	NA	0.621
*Di-n-butyl phthalate	5/59	0.002-2.738	0.02-0.023	NA	0.134
*Diethyl phthalate	6/59	0.001-1.369	0.025-0.049	NA	0.089

Table 5-5

(Page 2 of 2)

Analyte	Frequency of Detection[a]	Value or Range of Detection Limits (mg/kg)	Value or Range of Detected Concentrations (mg/kg)	Background Concentrations[b] (mg/kg)	Upper 95% Concentration[c] (mg/kg)
Inorganics					
Arsenic	16/58	2.0	2.2-6.0	2-97	2.0
*Beryllium	58/58	0.01-1.0	0.35-2.1	1.0-1.5	1.1
*Cadmium	9/58	0.40-67	0.60-0.90	NA	2.1
Chromium	58/58	0.70-2.0	7.4-88	15-200	23
*Copper	44/58	0.60-5.0	12-380	15-100	42
Lead	46/58	0.6-4.0	7.0-32	10-100	16
Mercury	2/54	0.1-0.2	0.17	0.01-0.48	0.076
Nickel	57/58	2.0-8.0	7.0-36	7-50	20
*Silver	31/58	0.70-2.0	0.90-2.6	NA	1.3
Zinc	46/58	0.20-4.0	31-150	25-150	61

*Chemical of potential concern.
NA = not available or not used for comparison.
ND = not detected.
[a]x/y where x = number of times detected and y = number of samples analyzed.
[b]Boerngen and Shaklette, 1981.
[c]IT, 1992b - calculations include nondetects at half the contract-required detection limit.

Table 5-6

Analytical Data Summary
Underground Storage Tank (ST-05) Soils
Williams Air Force Base

Analyte	Frequency of Detection[a]	Value or Range of Detection Limits mg/kg	Value or Range of Detected Concentrations mg/kg	Upper 95% Concentration mg/kg[b]
Organics				
*Ethyl benzene	6/16	5-25,000	0.005-49.2	11.41
*Toluene	2/16	0.005-25.0	1.95-4.83	3.017
*Xylenes	6/16	0.005-50.0	0.021-299.0	70.4

*Chemical of potential concern.

[a]x/y where x = number of times detected and y = number of samples analyzed
[b]IT, 1992b - calculations include nondetects at half the contract-required detection limit.

Table 5-7

Analytical Data Summary
Underground Storage Tank (ST-06) Soils
Williams Air Force Base

Analyte	Frequency of Detection[a]	Value or Range of Detection Limits (mg/kg)	Value or Range of Detected Concentrations (mg/kg)	Upper 95% Concentration[b] (mg/kg)
Organics				
*Ethyl benzene	1/16	0.005-0.25	0.88	0.174
*Xylenes	1/16	0.005-0.5	1.48	0.293

*Chemical of potential concern.

[a]x/y where x = number of times detected and y = number of samples analyzed
[b]IT, 1992b - calculations include nondetects at half the contract-required detection limit.

Table 5-8

Analytical Data Summary
Underground Storage Tank (ST-07) Soils
Williams Air Force Base

Analyte	Frequency of Detection[a]	Value or Range of Detection Limits (mg/kg)	Value or Range of Detected Concentrations (mg/kg)	Upper 95% Concentration[b] (mg/kg)
Organics				
*Methylene chloride	7/7	0.005-0.012	0.007-0.037	0.026

*Chemical of potential concern.

[a]x/y where x = number of times detected and y = number of samples analyzed
[b]IT, 1992b - calculations include nondetects at half the contract-required detection limit.

Table 5-9

Analytical Data Summary
Underground Storage Tank at Building 1085 (ST - 08) Soils
Williams Air Force Base

(Page 1 of 2)

Analyte	Frequency of Detection[a]	Value or Range of Detection Limits (mg/kg)	Value or Range of Detected Concentrations (mg/kg)	Range of Background[b] (mg/kg)	Upper 95% Concentration[c] (mg/kg)
Volatile Organics					
*Acetone	12/25	0.01-6.3	0.011-0.02	NA	0.475
*Methylene chloride	6/25	0.005-3.1	0.005-0.034	NA	0.026
*Tetrachloroethene	8/25	0.005-3.1	0.001-1.2	NA	0.303
*Xylenes	3/25	0.005-3.1	0.011-2.2	NA	4.3
Semivolatile Organics					
*4-Methylphenol	1/18	0.33-9.9	15	NA	3.368
Benzo(a)anthracene	1/14[d]	0.33-0.39	0.68	0.056-59.0	0.29
Benzo(a)pyrene	1/14[d]	0.33-0.39	0.37	0.0046-0.9	0.221
Benzo(b)fluoranthene	1/14[d]	0.33-0.39	0.43	0.058-62	0.234
Benzo(k)fluoranthene	1/14[d]	0.33-0.39	0.57	0.058-26	0.265
*Benzoic acid	1/10	1.6-1.9	1.6	NA	1.079
*Benzyl alcohol	2/10	0.33-0.39	0.31-0.53	NA	0.305
*Bis(2-ethylhexyl)phthalate	3/14	0.33-0.39	0.082-3.8	NA	1.026
*Chrysene	1/14[d]	0.33-0.39	0.65	0.078-0.64	0.283
*Di-n-butyl phthalate	1/14	0.33-0.39	0.047	NA	0.186

Table 5-9

Analyte	Frequency of Detection[a]	Value or Range of Detection Limits (mg/kg)	Value or Range of Detected Concentrations (mg/kg)	Range of Background[b] (mg/kg)	Upper 95% Concentration[c] (mg/kg)
*Diethyl phthalate	3/14	0.33-0.39	.035-0.065	NA	0.088
Fluoranthene	1/14[d]	0.33-0.39	1.300	0.120-166	0.430
*Phenanthrene	1/14[d]	0.33-0.39	1.300	0.048-0.14	0.430
Pyrene	1/14[d]	0.33-0.39	1.200	0.099-147	0.407
Inorganics					
*Antimony	3/3	12 - 15	15 - 31	<1	43
*Cadmium	1/3	1.0 - 2.0	2.0	NA	3.2
Chromium	3/3	2.0 - 3.0	18 - 41	15-100	58
Copper	3/3	5.0 - 8.0	13 - 21	15-200	27
Lead	3/3	1.0 - 2.0	10 - 30	10-100	45
Nickel	3/3	8.0 - 10	10 - 30	7-50	42
Zinc	3/3	4.0 - 5.0	32 - 85	25-150	124
*Cyanide	4/11	0.47 - 1.0	0.82 - 2.6	NA	1.2

*Chemical of potential concern
NA - not available or not used for comparison
[a]X/Y where x = number of times detected and y = number of samples analyzed.
[b]PAH background in agricultural and urban surface soils in the U.S. and other countries, ATSDR, 1989. Metals background from Boerngen and Shacklette, 1981.
[c]IT, 1992b - Calculations include nondetects at half the contract required detection limit.
[d]From surface soil sample 1085-P-1.

5.1.2 Chemicals of Potential Concern for Groundwater

5.1.2.1 Landfill (LF-04)

Chemicals detected in groundwater samples from LF-04 are listed in Table 5-10. The following chemicals were not selected as chemicals of potential concern for the reasons indicated:

- Benzoic acid, bromoform, chloroform, dibromochloromethane, diethyl phthalate, di-n-butyl phthalate, ethyl benzene, mercury, naphthalene, thallium, and xylenes were each detected in less than 5 percent of the groundwater samples and were not detected in any soil samples

- Arsenic, calcium, fluoride, iron, magnesium, and sodium were detected within the range of background for groundwater in the area

- Gross alpha and gross beta are analytical results that are not specific for a particular compound; therefore, neither were selected as chemicals of potential concern.

The remaining 23 chemicals listed in Table 5-10 are the chemicals of potential concern for groundwater in LF-04.

5.1.2.2 Fire Protection Training Area (FT-03)

Groundwater samples taken at the verified location of FT-03 indicated that groundwater has not been impacted above acceptable health levels by site activities; therefore, this site was not addressed in the risk assessment.

5.1.2.3 Northwest Drainage System (SD-10)

No groundwater sampling was performed within SD-10 because soils data collected during previous investigations indicated that there were no contaminants present in the deep soils and, consequently, it is unlikely that groundwater is affected. In addition, the net precipitation for the area is negative, indicating that infiltration is an unlikely transport mechanism to groundwater.

5.1.2.4 Radioactive Instrumentation Burial Area (RW-11)

No groundwater sampling was performed at RW-11 because soils data collected during previous investigations indicated that there were no contaminants present in the deep soils and, consequently, it is unlikely that groundwater is affected. In addition, the net

Table 5-10

Analytical Data Summary
Landfill (LF-04) Groundwater
Williams Air Force Base

Analyte	Frequency of Detection[a]	Range of Detection Limits (µg/L)	Range of Detected Concentration (µg/L)	Range of Background[b] (µg/L)	Average Concentration (µg/L)	Upper 95% Concentrations[c] (µg/L)
Organics						
*Acetone	3/3	10	2 - 5	NA	3.0	7.3
*Benzene	7/71	0.5 - 50	0.6 - 380	NA	6.0	17
Benzoic acid	1/31	10 - 50	3	NA	20	23
*Bis(2-ethylhexyl)phthalate	24/72	4 - 30	1.0 - 150	NA	6.0	10
*Bromodichloromethane	6/93	0.5 - 5.0	0.5 - 1.1	NA	0.35	0.44
Bromoform	1/93	0.5 - 5.0	0.8	NA	0.33	0.41
*Carbon disulfide	1/3	5	3	NA	2.7	3.4
Chloroform	4/93	0.5 - 5	0.6 - 1.2	NA	0.35	0.44
Dibromochloromethane	4/90	0.5	0.5 - 1.2	NA	0.28	0.305
Diethyl phthalate	3/72	2 - 30	2 - 3	NA	4.0	4.5
Di-n-butyl phthalate	2/7	4 - 30	0.9 - 12	NA	4.3	4.8
Ethyl benzene	2/71	0.5 - 25	0.6 - 1.8	NA	0.55	0.90
*Methylene chloride	16/93	0.5 - 26.0	1.4 - 7.6	NA	5.0	5.6
Naphthalene	1/72	2 - 30	2	NA	4.0	4.5
*Tetrachloroethene	21/93	0.5 - 5.0	1.0 - 4.3	NA	0.68	0.85

Table 5-10

(Page 2 of 3)

Analyte	Frequency of Detection[a]	Range of Detection Limits (µg/L)	Range of Detected Concentration (µg/L)	Range of Background[b] (µg/L)	Average Concentration (µg/L)	Upper 95% Concentrations[c] (µg/L)
Organics (Continued)						
*Toluene	9/71	0.5 - 25	0.5 - 4.4	NA	0.71	1.1
*Trichloroethene	11/93	0.5 - 5	0.5 - 2.4	NA	0.43	0.54
Xylenes	1/68	0.5 - 25	4.0	NA	0.84	1.2
Inorganics						
*Antimony	9/93	18 - 60	19.2 - 106	NA	21	23
Arsenic	9/93	1 - 10	1.1 - 17.7	1 - 44	2.4	2.9
*Beryllium	16/93	0.3 - 5	1.0 - 1.9	<0.5 - 0.7	1.1	1.3
*Bromide	8/15	900	900 - 1,700	NA	817	1,041
*Cadmium	7/93	2 - 5	2.5 - 14	<1.0	2.6	3.0
Calcium	5/5	5 - 5,000	160 - 190,000	3,500 - 280,000	38,200	143,600
*Chromium	39/93	3 - 10	3.8 - 11,000	17.2 - 181	294	566
*Copper	25/93	2 - 30	6 - 202	<10 - 30	13	18
Fluoride	8/15	200	1,200 - 2,300	200 - 2,400	927	1,400
Iron	3/5	0.1 - 100	0.1 - 0.2	5 - 160	10	38
*Lead	36/93	1 - 40	1.0 - 90	<10 - 14	6.7	9.6
Magnesium	5/5	5 - 5,000	32 - 40,000	2,600 - 57,000	8,037	30,220
*Manganese	5/5	0.02 - 20	0.09 - 80	<1 - 20	16	60
Mercury	4/92	0.2	0.22 - 0.3	NA	0.11	0.11

Table 5-10

(Page 3 of 3)

Analyte	Frequency of Detection[a]	Range of Detection Limits (µg/L)	Range of Detected Concentration (µg/L)	Range of Background[b] (µg/L)	Average Concentration (µg/L)	Upper 95% Concentrations[c] (µg/L)
*Nickel	37/93	7 - 40	9.8 - 15,000	60.8 - 914	235	556
*Nitrate	40/55	50 - 600	4,000 - 91,000	6,000 - 26,000	23,790	31,460
*Selenium	17/93	1 - 20	1.0 - 3.8	1 - 3	1.6	1.9
*Silver	36/93	3 - 70	3.0 - 18	NA	5.8	6.6
Sodium	5/5	5 - 5,000	54 - 61,000	52,000 - 260,000	12,250	46,088
Thallium	3/95	1 - 40	1.0 - 1.2	NA	4.96	6.35
*Zinc	71/93	2 - 20	6.8 - 2,700	<3 - 38	348	465
Gross alpha	5/15	2	9 - 13	NA	3.6	6.27
Gross beta	12/15	3	4 - 23	NA	8.17	11.90
*Uranium[d]	6/15	0.0015	0.003 - 0.0075	NA	0.0024	0.0036

*Chemical of potential concern
NA- Not available or not used for comparison
[a]x/y where x = number of times detected and y = number of samples analyzed.
[b]USGS, 1992 and project specific information for nitrate, nickel, and chromium (see Table 4-1).
[c]IT, 1992b - Calculations include nondetects at half the contract-required detection limit.
[d]Converted from pCi/L by the ratio 1.5 µg/pCi for naturally-occurring uranium (NCRP, 1984)

precipitation for the area is negative, indicating that infiltration is an unlikely transport mechanism to groundwater.

5.1.2.5 Pesticide Burial Area (DP-13)

No groundwater sampling was performed at DP-13 because soils data collected during previous investigations indicated that there were no contaminants present in the deep soils and, consequently, it is unlikely that groundwater is affected. In addition, the net precipitation for the area is negative, indicating that infiltration is an unlikely transport mechanism to groundwater. Also, the source of contamination has been removed.

5.1.2.6 Hazardous Materials Storage Area (SS-01)

No groundwater sampling was performed at SS-01 because soils data collected during previous investigations indicated that there were no contaminants present in the deep soils and, consequently, it is unlikely that groundwater is affected. In addition, the net precipitation for the area is negative, indicating that infiltration is an unlikely transport mechanism to groundwater.

5.1.2.7 USTs at Building 789 (ST-05)

No groundwater sampling was performed at ST-05 because soils data collected during previous investigations indicated that there were no contaminants present in the deep soils and, consequently, it is unlikely that groundwater is affected. In addition, the net precipitation for the area is negative, indicating that infiltration is an unlikely transport mechanism to groundwater. Also, the source of contamination has been removed.

5.1.2.8 USTs at Building 725 (ST-06)

No groundwater sampling was performed at ST-06 because soils data collected during previous investigations indicated that there were no contaminants present in the deep soils and, consequently, it is unlikely that groundwater is affected. In addition, the net precipitation for the area is negative, indicating that infiltration is an unlikely transport mechanism to groundwater. Also, the source of contamination has been removed.

5.1.2.9 USTs at Building 1086 (ST-07)

No groundwater sampling was performed at ST-07 because soils data collected during previous investigations indicated that there were no contaminants present in the deep soils and, consequently, it is unlikely that groundwater is affected. In addition, the net precipitation for the area is negative, indicating that infiltration is an unlikely transport mechanism to groundwater. Also, the source of contamination has been removed.

5.1.2.10 USTs at Building 1085 (ST-08)

No groundwater sampling was performed at ST-08 because soils data collected during previous investigations indicated that there was no significant contamination present in the soils below 26 feet and, consequently, it is unlikely that groundwater is affected based on contaminant fate and transport considerations discussed in Chapter 5.0 of the RI report. In addition, it is unlikely that groundwater is affected. In addition, the net precipitation for the area is negative, indicating that infiltration is an unlikely transport mechanism to groundwater. Also, the source of contamination has been removed.

5.1.3 Uncertainties

The following uncertainties are associated with the sample collection and analysis process.

- Potential contamination of samples during collection, preparation or analysis, and normal error in analytical techniques. These uncertainties are minimized by the laboratory validation process.

- Use of unvalidated data from the AV investigations.

- Use of regional background data rather than base-specific background data in the data evaluation process. This uncertainty will be addressed in Section 5.4.5.

5.2 Exposure Assessment

The exposure assessment involves the estimation of potential exposures of human or environmental receptors to chemicals found at the site. Exposure is defined as the contact of a receptor with a chemical. Exposure assessment is the estimation of the magnitude, frequency, and duration for each identified route of exposure. The magnitude of an exposure is determined by estimating the amount of chemical available at the receptor exchange boundaries (i.e., lungs or gastrointestinal [GI] tract) during a specified time period.

5.2.1 Potentially Exposed Populations

The objective of the receptor assessment is to identify potential human and environmental populations that may be exposed to site-related chemicals at Williams AFB under current and future land-use conditions. The assessment considers both on- and off-Base populations and their relationship to the potential migration pathways for site-related chemicals.

On-Base Land Use. When the risk assessment was conducted, the primary residential population at Williams AFB lived in the housing areas located on the northern, western, and southern portions of the Base. Now that the Base is closed, land use at the site could become residential, commercial, and/or agricultural.

On the basis of the land-use data from the Base during its active status, it was assumed that the current population on Base included sensitive subpopulations such as infants, children, elderly persons, and pregnant and nursing women. The Base is fenced, with security guards at the entrance, and is inaccessible to off-Base populations.

Future exposures to residential receptors will also be considered under the assumption that the Base property will be developed for residential purposes now that the Base has closed. It is assumed that future residential populations will also include sensitive subpopulations such as infants, children, elderly persons, and pregnant and nursing women.

Off-Base Land Use. Williams AFB is relatively isolated from any large metropolitan area. Located in Maricopa County, it is surrounded mostly by agricultural land.

The plan for the region is to develop the proposed area residentially and commercially during a 25-year period. If implemented, this development will dramatically impact the demographics and population around the Base.

5.2.2 Potential Exposure Pathways

For exposures to occur, complete exposure pathways must exist. A complete exposure pathway requires (EPA, 1989b):

- A source and mechanism for release of the chemical
- A point of potential human or environmental contact
- An exposure route at the exposure point.

If any one of these components is missing, the pathway is not complete. The following sections describe each of the exposure pathways at the individual sites evaluated at Williams AFB.

5.2.2.1 Landfill (LF-04)

All potential exposure pathways for contaminants included in the risk assessment for current and future land-use scenarios at LF-04 are summarized in Table 5-11.

Table 5-11

Summary of Potential Exposure Pathways
Landfill (LF-04)
Williams Air Force Base

Land Use Scenario	Environmental Media	Potentially Exposed Populations	Exposure Pathway
Current	Soil	Base Residents (Children)	Incidental ingestion of soil
			Dermal contact with soil
			Inhalation of chemicals volatilized from the soil
			Inhalation of fugitive dusts
		Base Workers	Incidental ingestion of soil
			Dermal contact with soil
			Inhalation of chemicals volatilized from the soil
			Inhalation of fugitive dust
Future	Groundwater	Residents	Ingestion of groundwater from downgradient wells
			Inhalation of chemicals volatilized from water during home use
			Dermal contact with chemicals in water during home use
			Ingestion of vegetables contaminated by irrigation
Future	Soil	Residents	Incidental ingestion of soil
			Dermal contact with soil
			Inhalation of chemicals volatilized from the soil
			Inhalation of fugitive dust
			Ingestion of homegrown vegetables

5.2.2.2 Fire Protection Training Area (FT-03)

All potential exposure pathways for contaminants included in the risk assessment for current and future land-use scenarios at FT-03 are summarized in Table 5-12. It should be noted that although FT-03 was not originally included in the risk assessment, Section 5.4.5 addresses a reevaluation of the OU-1 risk assessment that subsequently did include FT-03.

5.2.2.3 Northwest Drainage System (SD-10)

All potential exposure pathways for contaminants included in the risk assessment for current and future land-use scenarios at SD-10 are summarized in Table 5-13.

5.2.2.4 Radioactive Instrumentation Burial Area (RW-11)

All potential exposure pathways for contaminants included in the risk assessment for current and future land-use scenarios at RW-11 are summarized in Table 5-14.

5.2.2.5 Pesticide Burial Area (DP-13)

All potential exposure pathways for contaminants included in the risk assessment for current and future land-use scenarios at DP-13 are summarized in Table 5-15.

5.2.2.6 Hazardous Materials Storage Area (SS-01)

All potential exposure pathways for contaminants included in the risk assessment for current and future land-use scenarios at SS-01 are summarized in Table 5-16.

5.2.2.7 USTs (ST-05, ST-06, ST-07, ST-08)

All potential exposure pathways for contaminants included in the risk assessment for current and future land-use scenarios at UST sites are summarized in Table 5-17. Because contaminants remain in place at ST-05, ST-07, and ST-08, the residential scenario (the most conservative) was also evaluated to determine if the 5-year review process required by CERCLA is necessary for these sites. Section 5.6 verified that risks are within acceptable limits and that the 5-year review process is unwarranted.

5.2.2.8 Ingestion of Homegrown Fruits and Vegetables

The potential risk associated with the ingestion of homegrown fruits or vegetables irrigated with groundwater and grown in site soil was considered qualitatively. Developmental plans for the area indicate that commercial or residential expansion of the Base property are reasonable future scenarios. The water supply for such expansion, however, would come from currently functioning base wells or from the municipal water supply. It is extremely unlikely that contaminated groundwater under the site would be developed for commercial or

Table 5-12

Summary of Potential Exposure Pathways
Fire Protection Area No. 1 (FT-03)
Williams Air Force Base

Land Use Scenario	Environmental Media	Potentially Exposed Populations	Exposure Pathway
Current	Soil	Base Residents (Children)	Incidental ingestions of soil
			Dermal contact with soil
			Inhalation of chemicals volatilized from the soil
			Inhalation of fugitive dust
		Base Workers	Incidental ingestion of soil
			Dermal contact with soil
			Inhalation of chemicals volatilized from the soil
			Inhalation of fugitive dust
Future	Groundwater	Residents	Ingestion of groundwater from downgradient wells
			Inhalation of chemicals volatilized from water during home use
			Dermal contact with chemicals in water during home use
			Ingestion of vegetables contaminated by irrigation
Future	Soil	Residents	Incidental ingestion of soil
			Dermal contact with soil
			Inhalation of chemicals volatilized from the soil
			Inhalation of fugitive dust
			Ingestion of homegrown vegetables

Table 5-13

Summary of Potential Exposure Pathways
Northwest Drainage System (SD-10)
Williams Air Force Base

Land Use Scenario	Environmental Media	Potentially Exposed Populations	Exposure Pathway
Current	Soil	Base Residents (Children)	Incidental ingestion of soil
			Dermal contact with soil
			Inhalation of chemicals volatilized from the soil
			Inhalation of fugitive dusts
		Base Workers	Incidental ingestion of soil
			Dermal contact with soil
			Inhalation of chemicals volatilized from the soil
			Inhalation of fugitive dust
Future	Soil	Residents	Incidental ingestion of soil
			Dermal contact with soil
			Inhalation of chemicals volatilized from the soil
			Inhalation of fugitive dust
			Ingestion of homegrown vegetables

Table 5-14

Summary of Potential Exposure Pathways
Radioactive Instrumentation Burial Area (RW-11)
Williams Air Force Base

Land Use Scenario	Environmental Media	Potentially Exposed Populations	Exposure Pathway
Current	Soil	Base Workers	Incidental ingestion of soil
			Dermal contact with soil
			Inhalation of fugitive dust
Future	Soil	Residents	Incidental ingestion of soil
			Dermal contact with soil
			Inhalation of fugitive dust
			Ingestion of homegrown vegetables

Table 5-15

Summary of Potential Exposure Pathways
Pesticide Burial Area (DP-13)
Williams Air Force Base

Land Use Scenario	Environmental Media	Potentially Exposed Populations	Exposure Pathway
Current	Soil	Base Residents (Children)	Incidental ingestion of soil
			Dermal contact with soil
			Inhalation of chemicals volatilized from the soil
			Inhalation of fugitive dusts
		Base Workers	Incidental ingestion of soil
			Dermal contact with soil
			Inhalation of chemicals volatilized from the soil
			Inhalation of fugitive dust
Future	Soil	Residents	Incidental ingestion of soil
			Dermal contact with soil
			Inhalation of chemicals volatilized from the soil
			Inhalation of fugitive dusts
			Ingestion of homegrown vegetables

Table 5-16

Summary of Potential Exposure Pathways
Hazardous Materials Storage Area (SS-01)
Williams Air Force Base

Land Use Scenario	Environmental Media	Potentially Exposed Populations	Exposure Pathway
Current	Soil	Base Residents (Children)	Incidental ingestion of soil
			Dermal contact with soil
			Inhalation of chemicals volatilized from the soil
			Inhalation of fugitive dust
		Base Workers	Incidental ingestion of soil
			Dermal contact with soil
			Inhalation of chemicals volatilized from the soil
			Inhalation of fugitive dust
Future	Soil	Residents	Incidental ingestion of soil
			Dermal contact with soil
			Inhalation of chemicals volatilized from the soil
			Inhalation of fugitive dust
			Ingestion of homegrown vegetables

Table 5-17

Summary of Potential Exposure Pathways
Underground Storage Tanks (ST-05, ST-06, ST-07 and ST-08)
Williams Air Force Base

Land Use Scenario	Environmental Media	Potentially Exposed Populations	Exposure Pathway
Current	Soil	Base Workers	Incidental ingestion of soil
			Dermal contact with soil
			Inhalation of chemicals volatilized from the soil
			Inhalation of fugitive dust
Future	Soil	Residents	Incidental ingestion of soil
			Dermal contact with chemicals volatilized from the soil
			Inhalation of chemicals volatilized from the soil
			Inhalation of fugitive dust
			Ingestion of homegrown vegetables

residential use. It is reasonable to assume that residential orchards and gardens may be maintained; however, they would not be watered with contaminated groundwater from the site. Therefore, risk associated with ingestion of homegrown fruits and vegetables is not quantified.

5.2.3 Estimation of Exposure

This section describes the estimation of intakes of individual site-related chemicals of concern that may reach human receptors. The process involves:

- Identifying applicable human exposure models and input parameters
- Determining the concentration of each chemical in the identified environmental medium at the point of human exposure
- Estimating human intakes.

The methodologies and parameter values that will be used to quantitatively estimate chemical intakes for the risk assessment are presented in the RI report. In general, the magnitude of chemical intake depends on the exposure pathway and the variables that impact the transmittal of chemicals via that pathway. These intake estimates will be used in conjunction with chemical toxicity data to quantify the risks associated with each pathway.

For each identified pathway, a reasonable maximum exposure (RME) scenario was developed. This scenario gives a reasonable upper-bound estimate of the potential magnitude of an individual exposure to chemicals from the site. The intent of the RME as defined by the EPA (1989a) is to estimate a conservative exposure case (i.e., well above the average case) that is still within the range of possible exposures. The RME is estimated from a combination of average and upper-bound exposure assumptions to result in a reasonable maximum.

5.2.3.1 Exposure Models

The primary source for the exposure models used for this risk assessment is the Risk Assessment Guidance for Superfund Human Health Evaluation Manual (EPA, 1991a). The magnitude of chemical intake via the following exposure pathways is estimated by exposure models presented in detail in the RI report:

- Ingestion of drinking water
- Inhalation of fugitive dust and chemicals volatilized from soil
- Incidental ingestion of soil

- Dermal contact with soil
- Dermal contact with water
- Inhalation of VOCs during home water use.

5.2.3.2 Exposure Parameters

A combination of upper-bound and average exposure parameters have been used in each scenario to result in a combined RME. The exposure parameters used and the justifications for their selection are summarized in Table 5-18 and are explained more detail in the RI report. Upper-bound values are generally 90th or 95th percentile values, depending on availability for that parameter.

5.2.3.3 Exposure Point Concentrations

The concentration term in the intake equations is the arithmetic average of the concentration that is contacted by a receptor over the exposure period. Although this concentration does not reflect the maximum concentration that could be contacted at any one time, it is regarded as a reasonable estimate of the concentration likely to be contacted over time. Because of the uncertainty associated with any estimate of exposure concentration, the 95 percent upper confidence limit on the arithmetic average will be used for this variable.

The estimated exposure point concentrations for chemicals of potential concern at the sites within OU-1 are presented in Tables 5-19 through 5-26. (These tables are also in Chapter 6 of the RI report.) Generally, Tables 5-19 through 5-26 reflect the data in Tables 5-1 through 5-10. For DP-13 (Table 5-21) and ST-08 (Table 5-26), however, the exposure point concentrations reflect data for surface soil only (0-1 foot deep), and therefore, present only a subset of the data compiled in Table 5-4 and 5-9, respectively. A description of the approach used to estimate exposure concentrations is given in the following paragraphs.

Groundwater. To estimate the potential risks associated with completing a production well on the Base property, the upper 95th percent confidence limit of the arithmetic mean of the monitoring data for each chemical of potential concern was used as the value to represent the RME concentration. For samples with no detectable concentration of a chemical, a value of one-half the detection limit was incorporated into this computation as recommended by EPA guidance (EPA, 1989a).

For those sites with no groundwater sample data (SD-10, RW-11, DP-13, SS-01, ST-05, ST-06, ST-07, and ST-08), groundwater transport models were considered as a means for

Table 5-18

Parameters Used to Estimate Exposure
Williams Air Force Base

Parameter	Range	Value Used	Rationale
Residential Exposure: Ingestion of Groundwater from New Wells			
Adult Water Ingestion Rate (L/day)	1.4 Average 2.0 90th Percentile	2.0	Standard exposure factor (U.S. EPA, 1991c)
Exposure Frequency (days/year)	350 Reasonable 365 Worst-case	350	Parameter accounts for time spent away from home (U.S. EPA, 1991c)
Exposure Duration (years)	9 Average 30 90th Percentile	30	Upper 90th percentile for time spent in one residence (U.S. EPA, 1991c)
Body Weight (kg)		70	Standard exposure factor (U.S. EPA, 1991c)
Averaging Time for Noncarcinogenic Effects (days)		10,950	30 years x 365 days/years = 10,950 days (U.S. EPA, 1989a)
Averaging Time for Carcinogenic Effects (days)		25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989a)
Residential Exposure: Inhalation of Volatile Organic Compounds during Home Water Use (Water from New Wells)			
Adult Inhalation Rate (m^3/hr)		0.6	Represents light activity (U.S. EPA, 1991c)
Exposure Time (hours/day)	0.12 50th Percentile 0.20 90th Percentile	0.20	Reasonable maximum value (U.S. EPA, 1989a)
Exposure Frequency (days/year)	350 Reasonable 365 Worst-case	350	Parameter accounts for time spent away from home (U.S. EPA, 1991c)
Exposure Duration (years)	9 Average 30 90th Percentile	30	Upper 90th Percentile for time spent in one residence (U.S. EPA, 1991c)
Body Weight (kg)		70	Standard exposure factor (U.S. EPA, 1991c)
Averaging Time for Noncarcinogenic Effects (days)		10,950	30 years x 365 days/year = 10,950 days (U.S. EPA, 1989a)
Averaging time for Carcinogenic Effects (days)		25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989a)

Table 5-18

Parameter	Range	Value Used	Rationale
Residential Exposure: Dermal Contact with Chemicals in Water			
Skin Surface Area Available for Contact (cm^2)	19,400 - 50th Percentile (Adult Males) 16,900 - 50th Percentile (Adult Females)	18,150	The 50th percentile values for total skin surface area are cited as default factors for adults (U.S. EPA, 1989a). Male and female values were averaged.
Dermal Permeability Constant (cm/hr)		Chemical-specific values	Permeability values were obtained or derived as described by Schaum (1991).
Exposure Time (hours/day)	0.12 50th Percentile 0.20 90th Percentile	0.20	Values to address showering. Reasonable maximum value used (U.S. EPA, 1989a)
Exposure Frequency (days/year)	350 Reasonable 365 Worst-case	350	Parameter accounts for time away from home (U.S. EPA, 1991c)
Exposure Duration (years)	9 Average 30 90th Percentile	30	Upper 90th percentile for time spent in one residence (U.S. EPA, 1991c)
Adult Body Weight (kg)		70	Standard exposure factor (U.S. EPA, 1991c)
Averaging Time for Noncarcinogenic Effects (days)		10,950	30 years x 365 days/year = 10,950 days (U.S. EPA, 1989a)
Averaging Time for Carcinogenic Effects (days)		25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989a)
Residential Exposure: Incidental Ingestion of Soil (Juvenile)			
Juvenile Soil Ingestion Rate (kg/day)		.0002	Standard exposure factor for children 1 through 6 years old (U.S. EPA, 1991c)
Fraction Ingested from Contaminated Source (unitless)		1.0	Represents the fraction of the ingestion rate that is attributable to the source. Since the residence is the source, it is assumed that 100% of the soils/dusts are from that area. (U.S. EPA, 1989a)
Bioavailability Factor (unitless)		1.00 Metals	Worst-case estimate due to lack of data on bioavailability of inorganics in soil.
		.30 Organics	Based on work with soil-bound dioxins (Paustenbach et al., 1986)
Exposure Frequency (days/year)	350 Reasonable 365 Worst-case	350	Parameter accounts for time spent away from home (U.S. EPA, 1991c)
Exposure Duration (years)	Age-specific duration	6	Age-specific factors throughout the calculation (U.S. EPA, 1991c)
Juvenile Body Weight (kg)		15	Average body weight for juveniles 1 through 6 years old (U.S. EPA, 1991c)
Averaging Time for Noncarcinogenic Effects (days)	Age-specific averaging times	2,190 (juvenile)	6 years x 365 days/year = 2,190 days for juveniles (U.S. EPA, 1989a)
Averaging Time for Carcinogenic Effects (days)		25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989a)

Table 5-18

(Page 3 of 5)

Parameter	Range	Value Used	Rationale
Residential Exposure: Dermal Contact with Soil (Juvenile)			
Exposed Surface Area (cm^2/day), Juvenile		3,928	Assumes receptors expose their hands, arms, feet and legs to soil. Average surface area for children ages 3 to 9 years. (U.S. EPA, 1989b)
Soil to Skin Adherence Factors (mg/cm^2)		1.45	Standard default factor based upon adherence of commercial potting soil (U.S. EPA, 1989a)
Absorption Factor (unitless factor)		.05 - volatile organics 0.10 - semivolatile organics Pesticides/PCBs 0.01 - metals	U.S. EPA Region IX guidance
Exposure Frequency (days/year)	350 Reasonable 365 Worst-case	350	Parameter accounts for time spent away from home (U.S. EPA, 1991c)
Exposure Duration (years)	Age-specific duration	6	Standard exposure factor to be used in con-junction with age-specific factors throughout the calculation (U.S. EPA, 1991a)
Juvenile Body Weight (kg)		15	Average body weight for juveniles 1 through 6 years old. Standard exposure factor (U.S. EPA, 1991c)
Averaging Time for Noncarcinogenic Effects (days)		2,190 - juvenile	6 years x 365 days/year = 2,190 days for juveniles (U.S. EPA, 1989a)
Averaging Time for Carcinogenic Effects (days)		25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989a)
Residential Exposure: Inhalation of Volatiles/Fugitive Dusts (Adult)			
Adult Inhalation Rate (m^3/hour)	20 m^3/day (total) 15 m^3/day (indoor)	0.833	Represents reasonable maximum exposure that includes time outside and different types of activities. Standard exposure factor (U.S. EPA, 1991c).
Exposure Time (hours/day)		24	Worst-case exposure scenario
Exposure Frequency (days/year)	350 Reasonable 365 Worst-case	350	Standard exposure factor (U.S. EPA, 1991c)
Exposure Duration (years)	9 Average 30 90th Percentile	30	Upper 90th percentile for time spent in one residence (U.S. EPA, 1991c)
Body Weight (kg)		70	Standard exposure factor (U.S. EPA, 1991c)
Averaging Time for Noncarcinogenic Effects (days)		10,950	30 years x 365 days/year = 10,950 days for juveniles (U.S. EPA, 1989a)
Averaging Time for Carcinogenic Effects (days)		25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989a)

Table 5-18

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Parameter	Range	Value Used	Rationale
Occupational Exposure: Incidental Ingestion of Soil			
Adult Soil Ingestion Rate (kg/day)		0.00005	Standard exposure factor (U.S. EPA, 1991c)
Bioavailability Factor (unitless)		1.00 Metals	Worst-case estimate due to lack of data on bioavailability of inorganics in soil.
		.30 Organics	Based on work with soil-bound dioxins (Paustenbach et al., 1986)
Exposure Frequency (days/year)	100 Reasonable 250 Worst-case	250	Assumes workers are exposed 5 days/week, 50 weeks/year (U.S. EPA, 1991c)
Exposure Duration (years)		25	Standard exposure factor (U.S. EPA, 1991c)
Body Weight (kg)		70	Standard exposure factor (U.S. EPA, 1991c)
Averaging Time for Noncarcinogenic Effects (days)		9,125	25 years x 365 days/year = 9,125 days (U.S. EPA, 1989a)
Averaging Time for Carcinogenic Effects (days)		25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989a)
Occupational Exposure: Inhalation of Volatiles/Fugitive Dusts			
Adult Inhalation Rate (m^3/hour)		2.5	Standard exposure factor of 20 m^3/work day given in hourly rate (U.S. EPA, 1991c)
Exposure Time (hours/day)		8	Standard exposure factor (U.S. EPA, 1991c)
Exposure Frequency (days/year)	100 Reasonable 250 Worst-case	250	Assumes workers are exposed 5 days/week, 50 weeks/year (U.S. EPA, 1991c)
Exposure Duration (years)		25	Standard exposure factor (U.S. EPA, 1991c)
Body Weight (kg)		70	Standard exposure factor (U.S. EPA, 1991c)
Averaging Time for Noncarcinogenic Effects (days)		9,125	25 years x 365 days/year = 9,125 days (U.S. EPA, 1989a)
Averaging Time for Carcinogenic Effects (days)		25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989a)

Table 5-18

(Page 5 of 5)

Parameter	Range	Value Used	Rationale
Occupational Exposure: Dermal Contact with Soil			
Exposed Surface Area (cm^2/day)		1,933	Assumes workers expose arms and hands to soil (U.S. EPA, 1989b)
Soil to Skin Adherence Factor (mg/cm^2)		1.45	Standard default factor based upon adherence of commercial potting soil (U.S. EPA, 1989a)
Absorption Factor (unitless)		0.05-Volatile organics 0.10-Semivolatile organics, Pesticides/PCBs 0.01 - metals	U.S. EPA Region IX guidance
Exposure Frequency (days/year)	100 Reasonable 250 Worst-case	250	Assumes workers are exposed 5 days/week, 50 weeks/year (U.S. EPA, 1991c)
Exposure Duration (years)		25	Standard exposure factor (U.S. EPA, 1991c)
Body Weight (kg)		70	Standard exposure factor (U.S. EPA, 1991c)
Averaging Time for Noncarcinogenic Effects (days)		9,125	25 years x 365 days/year = 9,125 days (U.S. EPA, 1989a)
Averaging time for Carcinogenic Effects (days)		25,550	70 years x 365 days/year = 25,550 days (U.S. EPA, 1989a)

Table 5-19

Estimated Exposure-Point Concentrations for the Landfill (LF-04)
Williams Air Force Base

(Page 1 of 3)

Constituent	Exposure-Point Concentration Used	Rationale for Value Used
Dermal Contact and Ingestion - Groundwater		
Organics (µg/L)		Upper 95% confidence interval from groundwater data. A value of one-half the detection limit was used in the statistical calculations for undetected data.
Acetone	7.3	
Benzene	17	
Bis(2-ethylhexyl)phthalate	10	
Bromodichloromethane	0.44	
Carbon disulfide	3.4	
Methylene chloride	5.6	
Tetrachloroethene	0.85	
Toluene	1.1	
Trichloroethene	0.54	
Inorganics (µg/L)		
Antimony	23	
Beryllium	1.3	
Bromide	1041	
Cadmium	3.0	
Chromium	566	
Copper	18	
Lead	9.6	
Manganese	60	
Nickel	556	
Nitrate	31460	
Selenium	1.9	
Silver	6.6	
Zinc	465	
Uranium[a]	0.0036	

Table 5-19

Constituent	Exposure-Point Concentration Used	Rationale for Value Used
Inhalation of Volatiles From Groundwater		
Volatile Organics (mg/m^3)		Calculated from the upper 95% confidence interval for groundwater data using a home water-use volatilization model.
Acetone	5.18×10^{-4}	
Benzene	2.86×10^{-2}	
Bromodichloromethane	1.31×10^{-5}	
Carbon disulfide	6.54×10^{-3}	
Methylene chloride	7.61×10^{-3}	
Tetrachloroethene	1.60×10^{-3}	
Toluene	1.90×10^{-3}	
Trichloroethene	9.78×10^{-4}	
Dermal Contact and Incidental Ingestion - Soil		
Organics (mg/kg)		Calculated from the upper 95% confidence interval for soil data. A value of 1/2 the detection limit was used in the statistical calculations for undetected data.
1,2,4-Trichlorobenzene	0.679	
1,4-Dichlorobenzene	0.673	
4,4'-DDD	0.0072	
4,4'-DDE	0.064	
4,4'-DDT	0.067	
Alpha-chlordane	0.0025	
Beta-BHC	0.0041	
Bis(2-ethylhexyl)phthalate	0.613	
Di-n-butylphthalate	0.670	
Dieldrin	0.105	
Diethylphthalate	0.680	
Gamma-chlordane	0.0025	
Pentachlorophenol	1.666	
Inorganics (mg/kg)		
Beryllium	2.8	
Cadmium	0.84	
Thallium	0.17	
Zinc	116	

Table 5-19

(Page 3 of 3)

Constituent	Exposure-Point Concentration Used	Rationale for Value Used
Inhalation of Fugitive Dust		
Organics (mg/m^3)		Calculated from the upper 95% confidence interval for soil data, using a dust loading model.
1,2,4-Trichlorobenzene	6.79×10^{-8}	
1,4-Dichlorobenzene	6.73×10^{-8}	
4,4'-DDD	7.20×10^{-10}	
4,4'-DDE	6.40×10^{-9}	
4,4'-DDT	6.70×10^{-9}	
Alpha-chlordane	2.50×10^{-10}	
Beta-BHC	4.10×10^{-10}	
Bis(2-ethylhexyl)phthalate	6.13×10^{-8}	
Di-n-butylphthalate	6.70×10^{-8}	
Dieldrin	1.05×10^{-8}	
Diethylphthalate	6.80×10^{-8}	
Gamma-chlordane	2.50×10^{-10}	
Pentachlorophenol	1.67×10^{-7}	
Inorganics (mg/m^3)		
Beryllium	2.80×10^{-7}	
Cadmium	8.40×10^{-8}	
Thallium	1.70×10^{-8}	
Zinc	1.16×10^{-5}	
Inhalation of Volatiles From Soil		
No volatile organics were detected in landfill soils		

[a]Converted from 0.0024 pCi/L by the ratio 1.5 µg/pCi for naturally-occurring uranium (NCRP, 1984)

Table 5-20

Estimated Exposure-Point Concentrations for the Northwest Drainage System (SD-10) Williams Air Force Base

Constituent	Exposure-Point Concentration Used	Rationale for Value Used
Dermal Contact and Incidental Ingestion - Soil		
Organics (mg/kg)		Upper 95% confidence interval for soil data. A value of one-half the detection limit was used in the statistical calculations for undetected data.
Acetone	0.018	
Bis(2-ethylhexyl)phthalate	5.89	
Chloroform	0.740	
Methylene chloride	1.38	
Phenol	0.171	
Toluene	0.850	
Inorganics (mg/kg)		
Antimony	6.1	
Beryllium	0.95	
Cadmium	0.61	
Silver	1.3	
Inhalation of Fugitive Dust		
Organics (mg/m^3)		Calculated from the upper 95% confidence interval for soil data, using a dust loading model.
Acetone	1.80×10^{-9}	
Bis(2-ethylhexyl)phthalate	5.89×10^{-7}	
Chloroform	7.40×10^{-8}	
Methylene chloride	1.38×10^{-7}	
Phenol	1.71×10^{-8}	
Toluene	8.50×10^{-8}	
Inorganics (mg/m^3)		
Antimony	6.10×10^{-7}	
Beryllium	9.50×10^{-8}	
Cadmium	6.10×10^{-8}	
Silver	1.30×10^{-7}	
Inhalation of Volatiles from Soil		
Volatile Organics (mg/m^3)		Calculated from upper 95% confidence interval for soil data using a subsurface soil volatilization model.
Acetone	8.7×10^{-6}	
Chloroform	3.54×10^{-4}	
Methylene chloride	1.30×10^{-3}	
Toluene	5.15×10^{-5}	

Table 5-21

Estimated Exposure-Point Concentrations for the Pesticide Burial Area (DP-13) Williams Air Force Base

Constituent	Exposure-Point Concentration Used	Rationale for Value Used
Dermal Contact and Incidental Ingestion - Soil		
Organics (mg/kg)		Upper 95% confidence interval for surface soil data (samples from 0-1 foot). A value of one-half the detection limit was used in the statistical calculations for undetected data.
Acetone	0.036	
Toluene	0.0032	
Bis(2-ethylhexyl)phthalate	0.276	
Phenol	0.189	
Inorganics (mg/kg)		Upper 95% confidence interval for soil data (too few surface soil samples for meaningful statistics).
Antimony	41	
Inhalation of Fugitive Dust		
Organics (mg/m^3)		Calculated from the upper 95% confidence interval for surface soil data (samples from 0-1 foot) using a dust loading model.
Acetone	3.6×10^{-9}	
Toluene	3.19×10^{-10}	
Bis(2-ethylhexyl)phthalate	2.76×10^{-8}	
Phenol	1.89×10^{-8}	
Inorganics (mg/m^3)		Calculated from the upper 95% confidence interval for soil data.
Antimony	4.1×10^{-6}	
Inhalation of Volatiles from Soil		
Volatile Organics (mg/m^3)		Calculated from the upper 95% confidence interval for surface soil data (samples from 0-1 foot) using a surface soil volatilization model.
Acetone	2.99×10^{-1}	
Toluene	4.0×10^{-4}	

Table 5-22

Estimated Exposure-Point Concentrations for the Hazardous Materials Storage Area (SS-01) Williams Air Force Base

Constituent	Exposure-Point Concentration Used	Rationale for Value Used
Dermal Contact and Incidental Ingestion - Soil		
Organics (m/kg)		Calculated from the upper 95% confidence interval for soil data. A value of one-half the detection limit was used in the statistical calculations for undetected data.
Acetone	0.0065	
Ethyl benzene	0.691	
Methylene chloride	2.82	
Xylenes	1.55	
Di-n-butylphthalate	0.134	
Diethylphthalate	0.089	
Inorganics (mg/kg)		
Beryllium	1.1	
Cadmium	2.1	
Copper	42	
Silver	1.3	
Inhalation of Fugitive Dust		
Organics (mg/m^3)		
Acetone	6.50×10^{-10}	Calculated from the upper 95% confidence interval for soil data, using a dust loading model.
Ethyl benzene	6.91×10^{-8}	
Methylene chloride	2.82×10^{-7}	
Xylenes	1.55×10^{-7}	
Di-n-butylphthalate	1.34×10^{-8}	
Diethylphthalate	8.90×10^{-9}	
Inorganics (mg/m^3)		
Beryllium	1.1×10^{-7}	
Cadmium	2.1×10^{-7}	
Copper	4.2×10^{-6}	
Silver	1.3×10^{-7}	
Inhalation of Volatiles from Soil		
Volatile Organics (mg/m^3)		
Acetone	5.31×10^{-7}	Calculated from upper 95% confidence interval for soil data using a subsurface soil volatilization model.
Ethyl benzene	1.88×10^{-6}	
Methylene chloride	4.48×10^{-4}	
Xylenes	5.95×10^{-6}	

Table 5-23

Estimated Exposure-Point Concentrations for Building 789 USTs (ST-05) Williams Air Force Base

Constituent	Exposure-Point Concentration Used	Rationale for Value Used
Dermal Contact and Incidental Ingestion - Soil		
Organics (mg/kg)		Calculated from the upper 95% confidence interval for soil data. A value of one-half the detection limit was used in the statistical calculations for undetected data.
Ethyl benzene	11.4	
Toluene	3.02	
Xylenes	70.4	
Inhalation of Fugitive Dust		
Organics (mg/m^3)		Calculated from the upper 95% confidence interval for soil data, using a dust loading model.
Ethyl benzene	1.14×10^{-6}	
Toluene	3.02×10^{-7}	
Xylenes	7.04×10^{-6}	
Inhalation of Volatiles from Soil		
Volatile Organics (mg/m^3)		Calculated from upper 95% confidence interval for soil data using a subsurface soil volatilization model.
Ethyl benzene	4.05×10^{-5}	
Toluene	4.02×10^{-5}	
Xylenes	3.52×10^{-4}	

Table 5-24

Estimated Exposure-Point Concentrations for Building 725 USTs (ST-06) Williams Air Force Base

Constituent	Exposure-Point Concentration Used	Rationale for Value Used
Dermal Contact and Incidental Ingestion - Soil		
<u>Organics (mg/kg)</u> Ethyl benzene Xylenes	 0.174 0.293	Calculated from the upper 95% confidence interval for soil data. A value of one-half the detection limit was used in the statistical calculations for undetected data.
Inhalation of Fugitive Dust		
<u>Organics (mg/m^3)</u> Ethyl benzene Xylenes	 1.74×10^{-8} 2.93×10^{-8}	Calculated from the upper 95% confidence interval for soil data, using a dust loading model.
Inhalation of Volatiles from Soil		
<u>Volatile Organics (mg/m^3)</u> Ethyl benzene Xylenes	 2.75×10^{-7} 6.52×10^{-7}	Calculated from upper 95% confidence interval for soil data using subsurface soil volatilization model.

Table 5-25

Estimated Exposure-Point Concentrations for Building 1086 USTs (ST-07) Williams Air Force Base

Constituent	Exposure-Point Concentration Used	Rationale for Value Used
Dermal Contact and Incidental Ingestion - Soil		
Organics (mg/kg) Methylene chloride	0.026	Calculated from the upper 95% confidence interval for soil data. A value of one-half the detection limit was used in the statistical calculations for undetected data.
Inhalation of Fugitive Dust		
Organics (mg/m^3) Methylene chloride	2.60×10^{-9}	Calculated from the upper 95% confidence interval for soil data, using a dust loading model.
Inhalation of Volatiles from Soil		
Volatile Organics (mg/m^3) Methylene chloride	2.39×10^{-6}	Calculated from upper 95% confidence interval for soil data using a subsurface soil volatilization model.

Table 5-26

Estimated Exposure-Point Concentrations for Building 1085 USTs (ST-08) Williams Air Force Base

(Page 1 of 2)

Constituent	Exposure-Point Concentration Used	Rationale for Value Used
Dermal Contact and Incidental Ingestion - Soil		
Organics (mg/kg)		Upper 95% confidence interval for surface soil data (samples from 0-1 foot). A value of one-half the detection limit was used in the statistical calculations for undetected data.
Acetone	0.021	
Methylene chloride	ND	
Tetrachloroethene	ND	
Xylenes	ND	
4-Methyl phenol	ND	
Benzoic acid	1.22	
Benzyl Alcohol	0.370	
Bis(2-ethylhexyl)phthalate	0.434	
Chrysene	0.409	
Di-n-butylphthalate	ND	
Diethyl phthalate	ND	
Phenanthrene	0.729	
Inorganics (mg/kg)		
Antimony	43	
Cadmium	3.2	
Cyanide	1.2	
Inhalation of Fugitive Dust		
Organics (mg/m^3)		Calculated from the upper 95% confidence interval for surface soil data (samples from 0-1 foot) using a dust loading model.
Acetone	2.1×10^{-9}	
Methylene chloride	ND	
Tetrachloroethene	ND	
Xylenes	ND	
4-Methyl phenol	ND	
Benzoic acid	1.22×10^{-7}	
Benzyl alchohol	3.70×10^{-8}	
Bis(2-ethylhexyl)phthalate	4.34×10^{-8}	
Chrysene	4.09×10^{-8}	
Di-n-butylphthalate	ND	
Diethyl phthalate	ND	
Phenanthrene	7.29×10^{-8}	
Inorganics (mg/m^3)		
Antimony	4.3×10^{-6}	
Cadmium	3.2×10^{-7}	
Cyanide	1.2×10^{-7}	

Table 5-26

(Page 2 of 2)

Constituent	Exposure-Point Concentration Used	Rationale for Value Used
Inhalation of Volatiles from Soil		
Volatile Organics (mg/m^3)		Calculated from the upper 95% confidence interval for surface soil data (samples from 0-1 foot) using a surface soil volatilization model.
Acetone	2.47×10^{-3}	
Methylene chloride	ND	
Tetrachloroethene	ND	
Xylenes	ND	

ND = not detected in surface soils.

obtaining exposure point concentrations for future land-use conditions. It was concluded that it would not be appropriate to use such models for the following reasons. First, in cases where sources of contamination had been present at the site, the sources were removed. Second, chemicals of potential concern were not detected in soil boring samples collected at deep locations. Third, due to arid conditions in Arizona, it is assumed that the primary means of groundwater transport is evapotranspiration. Similarly, irrigation is not likely to result in saturation to the depths at which groundwater is located.

For sites with groundwater sample data (LF-04), the upper 95th percent confidence limit of the arithmetic mean of the current monitoring data was used as a future RME concentration. It was expected that future concentrations in groundwater would be less than those represented by the current exposure point concentrations due to degradation and/or dilution during transport. In the near future, however, it is not known whether groundwater concentrations directly beneath LF-04 would be higher than concentrations observed in wells on the periphery. Subsurface samples were not collected directly in the landfill. The use of current data for the RME excludes both the potential for increased concentrations in the near future and decreased concentrations in the more distant future. This assumption of steady-state conditions should result in a health-protective estimate because exposure is not anticipated in the near future. If it does occur, the exposure assumptions used will provide health-protective cleanup standards.

Indoor Air. The RME concentration for the inhalation of volatiles from groundwater was calculated from the upper 95^{th} percent confidence limit of the arithmetic mean of the groundwater monitoring data using a home water use volatilization model. The models used to estimate the concentration of volatiles in household air from general household water use are based on a combination of volatilization from general household water use and volatilization while showering.

Soil. Soil samples were analyzed from depths less than 1 foot to 210 feet bls. For purposes of exposure modeling, for sites with more than three surface soil samples, surface soils were summarized separately (DP-13, FT-08, and LF-04). An RME concentration was estimated as the upper 95th percent confidence limit of the arithmetic mean of the sampling data for each chemical of potential concern in each group. (For samples with no detectable concentration of a chemical, a value of one-half the detection limit was incorporated in this computation.) RME will tend to overestimate exposure to surface soils, especially in the future, because concentrations are expected to decrease with time through weathering and volatilization.

Volatilization from Soils. Receptors in the site areas could potentially be exposed to vapor-phase chemicals due to volatilization of organic compounds present in the surface or subsurface soils. Volatilization and dispersion models were used to estimate air concentrations of VOCs based on their concentrations in soil. A VOC flux from soil was calculated, then air dispersion was modeled for on-site receptors. Model assumptions and parameters are presented in the RI report. The upper 95th percent confidence limit of the arithmetic mean of the soil data was used to estimate the potential concentration of chemicals in the air due to volatilization.

Fugitive Dust. Estimating airborne concentrations of contaminants in the particulate phase involves modeling resuspension and dispersion. Resuspension of hazardous chemical and radionuclide contaminants may be estimated using a simple dust loading equation. These methods are useful for estimating exposure concentrations of contaminants in air for workers involved in remediation activities at the contaminant release point. The dust loading equation used to estimate contaminant concentrations in resuspended dust is based on the contaminant concentration in surface soil and a dust loading factor.

5.2.3.4 Uncertainties

Several sources of uncertainty in the exposure assessment process may ultimately impact the risk assessment. These sources can be generally categorized as: current and future land-use assumptions, environmental sampling and analysis, evaluation of exposure pathways, and exposure parameter values.

5.3 Toxicity Assessment

5.3.1 Contaminant Toxicity Information

This section provides information regarding the type and severity of adverse health effects associated with exposure to the chemicals of potential concern in groundwater and soil and a measure of the dose/response relationship for each. These dose/response relationships are provided in the form of EPA-approved reference doses (RfD) and cancer potency factors (CPF). This information is summarized in Tables 5-27 and 5-28. CPFs have been developed by EPA's Carcinogenic Assessment Group (CAG) for estimating excess cancer risks associated with exposure to potentially carcinogenic chemicals. CPFs, which are expressed in units of risk per mg/kg-day, are multiplied by the estimated intake of a potential carcinogen, in mg/kg-day, to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upper bound" reflects the

Table 5-27

Summary of Reference Doses (RfD) Williams Air Force Base

(Page 1 of 6)

Constituent	Oral Reference Dose (RfD) (mg/kg-day)	Critical Effect	Uncertainty Factor	Inhalation Reference Dose (RfD) (mg/kg-day)	Critical Effect	Uncertainty Factor
Acetone	1.00×10^{-1}	Increased liver and kidney weight; nephrotoxicity	1000	NL	NL	NL
Antimony	4.00×10^{-4}	Longevity, blood glucose, cholesterol	1000	NL	NL	NL
Benzene	NL	NL	NL	NL	NL	NL
Benzoic acid	4.00	No adverse effects; human daily per capita intake	1	NL	NL	NL
Benzyl alcohol	3.00×10^{-1} [a]	Hyperplasia of the epithelium of the forestomach	1000	NL	NL	NL
Beryllium	5.00×10^{-3} [b]	No adverse effects	100	NL	NL	NL
Beta-BHC	NL	NL	NL	NL	NL	NL
Bis(2-ethylhexyl)phthalate	2.00×10^{-2}	Increased relative liver weight	1000	NL	NL	NL
Bromide	NL	NL	NL	NL	NL	NL
Bromodichloromethane	2.00×10^{-2}	Renal cytomegaly	1000	NL	NL	NL
Cadmium	5.00×10^{-4} (water)	Significant proteinuria	10	NL	NL	NL

Table 5-27

(Page 2 of 6)

Constituent	Oral Reference Dose (RfD) (mg/kg-day)	Critical Effect	Uncertainty Factor	Inhalation Reference Dose (RfD) (mg/kg-day)	Critical Effect	Uncertainty Factor
Cadmium	1.00×10^{-3} (food)	Chronic exposures	10			
Carbon disulfide	1.00×10^{-1}	Fetal toxicity; malformations	100	2.90×10^{-3} [a,g]	Fetal toxicity	1000
Chlordane (alpha and gamma)	6.00×10^{-5} [c]	Regional liver hypertrophy in females	1000	NL	NL	NL
Chloroform	1.00×10^{-2}	Fatty cyst formation in liver	1000	NL	NL	NL
Chromium	5.00×10^{-3} [d]	No effect observed	500	5.70×10^{-2} [a,g,h]	Nasal mucosal atrophy	300
Chrysene	NL	NL	NL	NL	NL	NL
Copper	3.71×10^{-2} [e]	Local gastrointestinal irritation	NL	NL	NL	NL
Cyanide	2.00×10^{-2}	Weight loss, thyroid effects, myelin degeneration	UF = 100 MF = 5	NL	NL	NL
4,4-DDD	NL	NL	NL	NL	NL	NL
4,4-DDE	NL	NL	NL	NL	NL	NL
4,4-DDT	5.00×10^{-4}	Liver lesions	100	NL	NL	NL

Table 5-27

Constituent	Oral Reference Dose (RfD) (mg/kg-day)	Critical Effect	Uncertainty Factor	Inhalation Reference Dose (RfD) (mg/kg-day)	Critical Effect	Uncertainty Factor
1,2-Dichlorobenzene	9.00×10^{-2}	No adverse effects observed	1000	4.00×10^{-2} [a]	Decreased body weight gain	1000
1,4-Dichlorobenzene	NL	NL	NL	2.00×10^{-1} [a,g]	Liver and kidney effects	100
Dieldrin	5.00×10^{-5}	Hepatic lesions	100	NL	NL	NL
Diethylphthalate	8.00×10^{-1}	Decreased growth rate, food consumption and altered organ weights	1000	NL	NL	NL
Dimethylphthalate	1.00	Minor effect on growth; nephritic involvement	100	NL	NL	NL
Di-n-butylphthalate	1.00×10^{-1}	Increased mortality	1000	NL	NL	NL
Di-n-octylphthalate	2.00×10^{-2} [a]	Elevated kidney and liver weights; increased SGOT and SGPT	1000	NL	NL	NL
Ethyl alcohol	NL	NL	NL	NL	NL	NL
Ethyl benzene	1.00×10^{-1}	Liver and kidney toxicity	1000	2.86×10^{-1} [g]	Developmental toxicity	300
Lead	7.00×10^{-4} [i]			6.00×10^{-4} [i]		

Table 5-27

(Page 4 of 6)

Constituent	Oral Reference Dose (RfD) (mg/kg-day)	Critical Effect	Uncertainty Factor	Inhalation Reference Dose (RfD) (mg/kg-day)	Critical Effect	Uncertainty Factor
Manganese	1.00×10^{-1}	Central nervous system effects	1	1.10×10^{-4} [a,g]	Respiratory symptoms, psychomotor disturbances	1
Mercury	3.00×10^{-4} [a]	Kidney effects	1000	8.6×10^{-5} [a,g]	Neurotoxicity	30
Methyl ethyl ketone	5.00×10^{-2} [a]	Fetotoxicity	1000	9.00×10^{-2} [a]	Central nervous system	1000
Methylene chloride	6.00×10^{-2}	Liver toxicity	100	8.60×10^{-1} [a,g]	NL	100
4-Methylphenol	NL	NL	NL	NL	NL	NL
Nickel	2.00×10^{-2}	Decreased body and organ weight	UF = 100 MF = 3	NL	NL	NL
Nitrate	1.60	Early clinical signs of methemoglobinemia	1	NL	NL	NL
Pentachlorophenol	3.00×10^{-2}	Liver and kidney pathology	100	NL	NL	NL
Phenanthrene	NL	NL	NL	NL	NL	NL
Phenol	6.00×10^{-1}	Reduced fetal body weight in rats	100	NL	NL	NL
Pyrene	3.00×10^{-2}	Kidney effects	3000	NL	NL	NL
Selenium	5.00×10^{-3}	Clinical selenosis	3	NL	NL	NL
Silver	3.00×10^{-3} [a]	Argyria	2	NL	NL	NL

Table 5-27

Constituent	Oral Reference Dose (RfD) (mg/kg-day)	Critical Effect	Uncertainty Factor	Inhalation Reference Dose (RfD) (mg/kg-day)	Critical Effect	Uncertainty Factor
Tetrachloroethene	1.00×10^{-2}	Hepatotoxicity in mice; weight gain in rats	1000	NL	NL	NL
Thallium	7×10^{-5} [a]	Increase in liver enzymes, alopecia	3000	NL	NL	NL
Toluene	2.00×10^{-1}	Changes in liver and kidney weights	1000	6.00×10^{-1} [a,g]	Central nervous system effects; eyes and nose irritation	100
1,2,4-Trichlorobenzene	1.31×10^{-3} [a]	Porphyria	1000	3.00×10^{-3} [a]	Increased uroporphyrin	1000
Trichloroethene	NL	NL	NL	NL	NL	NL
Uranium	3.00×10^{-3} [f]	Nephrotoxicity	1000	NL	NL	NL
Xylenes	2.00	Hyperactivity, decreased body weight, and increased mortality in males	100	9.00×10^{-2} [a,g]	Central nervous system effects; nose and throat irritation	100
Zinc	2.00×10^{-1} [a]	Anemia	10	NL	NL	NL

NA - not applicable
NL - not listed
UF - uncertainty factor
MF - modifying factor

Table 5-27

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The source of the toxicity values is the Integrated Risk Information System (IRIS; U.S. EPA, 1991b) unless otherwise indicated in the footnotes.
[a]Value obtained from the Health Effects Assessment Summary Tables (HEAST); U.S. Environmental Protection Agency; Office of Emergency and Remedial Response; OERR 9200.6-303(91-1); January 1991.
[b]Value based upon soluble salts of beryllium.
[c]Value for gamma-chlordane was used.
[d]Value for potassium chromate used as most conservative estimate.
[e]Value was converted from the drinking water standard for copper (1.3 mg/L), which was identified in HEAST. The standard default factors for intake were applied.
[f]Value based on effects of toxicity rather than effects associated with ionizing radiation
[g]Value converted from Reference Concentration (RfC) to RfD according to method in HEAST.
[h]Value based upon Chromium VI.
[i]Values for lead are based on Marcus, 1986.

Table 5-28

Summary of Slope Factors (CPF)
Williams Air Force Base

Constituent	Oral Slope Factor (CPF) $(mg/kg\text{-}day)^{-1}$	Weight of Evidence	Type of Cancer	Inhalation Slope Factor (CPF) $(mg/kg\text{-}day)^{-1}$	Weight of Evidence	Type of Cancer
Acetone	NA	D	NA	NA	D	NA
Antimony	NE	NE	NE	NE	NE	NE
Benzene	2.90×10^{-2}	A	Leukemia	2.90×10^{-2} [a]	A	Leukemia
Benzoic acid	NA	D	NA	NA	D	NA
Benzyl alcohol	NL	NL	NL	NL	NL	NL
Beryllium	4.30	B2	Total tumors	8.40[a]	B2	Lung
Beta-BHC	1.80[a]	C	Liver	1.80[a]	C	NL
Bis(2-ethylhexyl)phthalate	1.40×10^{-2}	B2	Liver	NL	B2	NL
Bromide	NL	NL	NL	NL	NL	NL
Bromodichloromethane	1.30×10^{-1}	B2	Kidney, large intestine, liver	NL	B2	NL
Cadmium	NL	B1	NL	6.10	B1	Respiratory tract
Carbon disulfide	NE	NE	NE	NE	NE	NE
Chlordane (alpha)	1.30[b]	B2	Liver	1.30[b]	B2	Liver
Chlordane (gamma)	1.30	B2	Liver	1.30[a]	B2	Liver
Chloroform	6.10×10^{-3}	B2	Kidney	8.10×10^{-2} [a]	B2	Liver

Table 5-28

Constituent	Oral Slope Factor (CPF) (mg/kg-day)$^{-1}$	Weight of Evidence	Type of Cancer	Inhalation Slope Factor (CPF) (mg/kg-day)$^{-1}$	Weight of Evidence	Type of Cancer
Chromium	NL	NL	NL	4.10×10^{1} [a]	A	Lung
Chrysene	NL	B2	Lymphoma, skin	NL	B2	NL
Copper	NA	D	NA	NA	D	NA
Cyanide	NA	D	NA	NA	D	NA
4,4-DDD	2.40×10^{-1} [a]	B2	Liver	NL	B2	NL
4,4-DDE	3.40×10^{-1} [a]	B2	Liver	NL	B2	NL
4,4-DDT	3.40×10^{-1} [a]	B2	Liver	3.40×10^{-1} [a]	B2	Liver
1,2-Dichlorobenzene	NA	D	NA	NA	D	NA
1,4-Dichlorobenzene	2.40×10^{-2} [a]	C	Liver	NL	C	NL
Dieldrin	1.60×10^{1}	B2	Liver	1.60×10^{1} [c]	B2	Liver
Diethylphthalate	NA	D	NA	NA	D	NA
Dimethylphthalate	NA	D	NA	NA	D	NA
Di-n-butylphthalate	NA	D	NA	NA	D	NA
Di-n-octylphthalate	NL	NL	NL	NL	NL	NL
Ethyl alcohol	NL	NL	NL	NL	NL	NL
Ethyl benzene	NA	D	NA	NA	D	NA
Lead	NL	B2	NL	NL	B2	NL
Manganese	NA	D	NA	NA	D	NA
Mercury	NA	D	NA	NA	D	NA

Table 5-28

(Page 3 of 4)

Constituent	Oral Slope Factor (CPF) (mg/kg-day)$^{-1}$	Weight of Evidence	Type of Cancer	Inhalation Slope Factor (CPF) (mg/kg-day)$^{-1}$	Weight of Evidence	Type of Cancer
Methyl ethyl ketone	NA	D	NA	NA	D	NA
Methylene chloride	7.50×10^{-3}	B2	Liver	1.65×10^{-3} [d]	B2	Lung, liver
4-Methylphenol	NL	C	Skin papilloma	NL	NL	NL
Nickel	NE	NE	NE	1.70[e]	A	Respiratory tract
Nitrate	NL	NL	NL	NL	NL	NL
Pentachlorophenol	1.20×10^{-1} [e]	B2	Liver, adrenal, circulatory system	NL	B2	NL
Phenanthrene	NA	D	NA	NA	D	NA
Phenol	NA	D	NA	NA	D	NA
Pyrene	NA	D	NA	NA	D	NA
Selenium	NA	D	NA	NA	D	NA
Selenium sulfide	NL	B2	NL	NL	B2	NL
Silver	NA	D	NA	NA	D	NA
Tetrachloroethene	5.10×10^{-2} [e]	B2	Liver	1.80×10^{2} [e,d]	B2	Leukemia, liver
Thallium	NL	NL	NL	NL	NL	NL
Toluene	NA	D	NA	NA	D	NA
1,2,4-Trichlorobenzene	NA	D	NA	NA	D	NA
Trichloroethene	1.10×10^{-2} [e]	B2	Liver	1.70×10^{-2} [e]	B2	Lung

Table 5-28

(Page 4 of 4)

Constituent	Oral Slope Factor (CPF) $(mg/kg\text{-}day)^{-1}$	Weight of Evidence	Type of Cancer	Inhalation Slope Factor (CPF) $(mg/kg\text{-}day)^{-1}$	Weight of Evidence	Type of Cancer
Uranium	NL	NL	NL	NL	NL	NL
Xylenes	NA	D	NA	NA	D	NA
Zinc	NA	D	NA	NA	D	NA

NA - Not applicable
NE - Chemical has not been evaluated for carcinogenicity.
NL - Not listed

The source of the toxicity values is the Integrated Risk Information System (IRIS; U.S. EPA, 1991b) unless otherwise indicated in the footnotes.
[a]Values obtained from the Health Effects Assessment Summary Tables (HEAST); U.S. Environmental Protection Agency.
[b]Value for gamma-chlordane was used in absence of value for alpha-chlordane.
[c]Based on oral data
[d]Value converted from unit risk estimate to CPF using conversion method in HEAST.

conservative estimate of the risks calculated from the CPF. Use of this approach makes underestimation of the actual cancer risk highly unlikely. CPFs are derived from the results of human epidemiological studies or chronic animal bioassays to which animal-to-human extrapolation was applied.

RfDs have been developed by EPA for indicating the potential for adverse health effects from exposure to chemicals exhibiting noncarcinogenic effects. RfDs, which are expressed in units of mg/kg-day, are estimates of chronic daily exposure levels for humans, including sensitive individuals. Estimated intakes of chemicals from environmental media (e.g., the amount of chemical ingested from contaminated drinking water) can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans). These uncertainty factors help ensure that the RfDs will not underestimate the potential for adverse noncarcinogenic effects to occur. Further detailed information concerning the toxicity of individual chemicals is presented in Section 6.4 of the OU-1 RI report.

5.3.2 Uncertainties

EPA addressed uncertainties associated with the RfDs for each chemical by modifying the results of animal and human studies by factors of (usually) 10, 100, or 1,000. An uncertainty factor of 10 is used when the RfD is based on chronic human studies. An uncertainty factor of 100 is used to account for the extrapolation of data from animals to humans when the RfD is based on experimental animal data. An uncertainty factor of 1,000 is used when the RfD is based on an animals' lowest observed effect level (LOEL) instead of a no observed effect level (NOEL). These uncertainty factors are designed to overestimate, rather than underestimate threshold limits for humans.

There are also several sources of uncertainty inherent in cancer slope factors. The weight-of-evidence classification is a qualitative estimate of the likelihood that a chemical will induce cancer in humans. These range from Group A (human carcinogen - sufficient evidence of carcinogenicity in humans) to Group E (evidence of noncarcinogenicity in adequate studies). Other uncertainties, as with RfDs, arise from high to low dose extrapolations, animal to human extrapolations, and intraspecies variation in experimental animals or human populations.

5.4 Risk Characterization

This section addresses the potential for adverse health effects (both cancer and other toxic effects) based on a quantitative characterization of risk. The risk characterization takes into account the magnitude of exposure to a chemical of potential concern (dose), as discussed in Section 5.2, and the chemical's toxicity (Section 5.3). Risks are characterized for carcinogenic chemicals in terms of ILCR, and for noncarcinogenic chemicals with other toxic effects in terms of a hazard index (HI). Both of these are discussed in the following sections.

5.4.1 Carcinogenic Effects

ILCRs were estimated for each potentially carcinogenic chemical. ILCR is expressed in terms of additional cancers that might be anticipated as a result of specific exposure to an external influence. Thus, a 1 x 10^{-6} ILCR indicates that one additional person in one million is likely to develop some form of cancer or that an exposed individual has an additional one-in-one million chance of developing cancer. Estimation of ILCR is given by:

$$ILCR = (CPF)(CDI)$$

where:

ILCR = Incremental lifetime cancer risk (unitless)
CPF = Carcinogenic slope factor [$(mg/kg/day)^{-1}$]
CDI = Chronic daily intake (mg/kg/day),equivalent to average daily intake.

The CPFs used are the most recent values developed by the CAG of EPA as cited in the Integrated Risk Information System (IRIS) database (EPA, 1991b) and Health Effects Assessment Summary Tables (HEAST) (EPA, 1991c).

In weighing acceptable residential exposures to potentially carcinogenic compounds, EPA recommends the use of an acceptable risk range of 10^{-4} to 10^{-6} for CERCLA sites (EPA, 1990). EPA also uses an incremental lifetime risk level of one in one million as a point of departure for developing drinking water standards (EPA, 1987). The maximum acceptable ILCR recommended by the EPA for drinking water is 10^{-4} (EPA, 1987).

EPA recommends that site-specific factors, such as the likelihood that the exposure assumptions used will be fulfilled, be considered when deciding where in the risk range of 10^{-4} to 10^{-6} a specific site should fail to be acceptable (EPA, 1990).

5.4.2 Noncarcinogenic Effects

Chemicals that produce health effects other than cancer were evaluated in terms of their relative hazard when compared to acceptable exposure levels. The hazard quotient (HQ) for exposure to noncarcinogens based on the ratio of the estimated daily intake to an acceptable daily exposure is as follows:

$$HQ_{i,p} = D_{i,p}/RfD_i$$

where:

$HQ_{i,p}$ = Individual hazard quotient for exposure to constituent i through exposure pathway p
$D_{i,p}$ = Daily intake via a specific pathway for constituent i (mg/kg-day)
RfD_i = Reference dose for exposure by the specific pathway for constituent i (mg/kg-day)

The HQ does not define intake response relationships and its numerical value should not be construed to be a probabilistic estimate of risk. It is a numerical proximity to acceptable limits of exposure or the degree to which acceptable exposure levels are exceeded. As this index approaches unity, concern for the potential hazard of the constituent increases. Exceeding unity does not in itself imply a potential hazard; however, it does suggest that a given situation should be more closely scrutinized.

The sum of all HQs for a given pathway or medium is the HI. The EPA advocates the use of total HI for a mixture of components based on the assumption of response additivity. Summation of the individual HQs could result in an HI that exceeds 1, even if no single chemical exceeds its acceptable level. Mechanistically, it is not appropriate to sum HQs unless the constituents that make up the mixture have similar modes of action on the identical organ. Consequently, the summing of HQs for a mixture of compounds that are not expected to induce the same type of effects could overestimate the potential risk. The EPA recommends that if the total HI is greater than unity, the components of the mixture should be grouped by critical effect and separate HIs derived for each effect. Critical effects are described in the HEAST documents and in IRIS (EPA, 1991a,b), and are summarized in Table 5-27.

5.4.3 Chemicals with No Published Toxicity Values

4-Methylphenol. In the absence of toxicity values for 4-methylphenol, the potential risks were evaluated qualitatively. 4-Methylphenol was detected in one of 18 soil samples from ST-08; however, 4-methylphenol was not detected in the surface soils. The upper 95 percent concentration calculated for this compound is 3.37 mg/kg. The exposure pathways that were investigated for ST-08 include: incidental ingestion of soils, dermal contact with soil, inhalation of volatiles from soils, and inhalation of fugitive dusts. Given that 4-methylphenol was detected only once in the subsurface soils, it was concluded that significant exposure to this chemical is unlikely.

Phenanthrene. In the absence of toxicity values, the potential toxicity of phenanthrene was evaluated qualitatively. Phenanthrene was detected in one of seven surface soil samples from ST-08. The upper 95 percent concentration was 0.729 mg/kg. The exposure pathways that were investigated for ST-08 include: incidental ingestion of soils, dermal contact with soil, inhalation of volatiles from soils, and inhalation of fugitive dusts. Due to the low frequency at which this compound was detected, the presence of phenanthrene in the surface soils is not expected to contribute significantly to the HI for ST-08. Because this chemical has a Group D designation for carcinogenicity, there are no cancer risks associated with phenanthrene.

5.4.4 Results of Risk Characterization

5.4.4.1 Landfill (LF-04)

Risk characterization results for LF-04 are presented in Appendix F.3 of the RI report and summarized in Table 5-29.

Under the current and future residential scenarios, the ILCRs for the incidental ingestion of soil and ingestion of groundwater were within the target risk range of 1×10^{-6} to 1×10^{-4}. Major contributors to risk were beryllium in groundwater and soils, benzene in groundwater, and dieldrin in soils. Ingestion of groundwater also led to an HI greater than unity, due primarily to antimony and chromium.

Under the occupational scenario, the ILCR for incidental ingestion of soil was within the target risk range, primarily due to beryllium and dieldrin. No HIs were greater than unity for this scenario.

Table 5-29

Summary of Risk Characterization Results
Landfill (LF-04)
Williams Air Force Base

Exposure Pathway	Total Hazard Index	Primary Contributor(s)	Total ILCR	Primary Contributor(s)
Current and Future Residential Scenarios				
Ingestion of Groundwater[a]	6.71	Antimony, chromium	7.48×10^{-5}	Beryllium, benzene
Inhalation of Volatiles from Groundwater[a]	1.16×10^{-4}	Carbon disulfide	1.76×10^{-8}	Benzene
Dermal Contact with Groundwater[a]	1.61×10^{-4}	Chromium	1.20×10^{-7}	Beryllium
Total Groundwater ILCR:			7.49×10^{-5}	
Dermal Contact with Soil	1.07×10^{-1}	Dieldrin, 1,2,4-trichloro-benzene	6.13×10^{-6}	Dieldrin
Incidental Ingestion of Soil	6.76×10^{-2}	Cadmium, thallium	1.38×10^{-5}	Beryllium
Inhalation of Fugitive Dust	2.16×10^{-4}	Thallium, dieldrin	3.59×10^{-7}	Beryllium
Inhalation of Volatiles from Soil	Not quantified[b]		Not quantified[b]	
Total Soil ILCR:			2.03×10^{-5}	
Current Occupational Scenario				
Dermal Contact with Soil	8.04×10^{-3}	Dieldrin, 1,2,4-trichloro-benzene	1.92×10^{-6}	Dieldrin
Incidental Ingestion of Soil	2.59×10^{-3}	Thallium	2.21×10^{-6}	Beryllium
Inhalation of Fugitive Dust	1.54×10^{-4}	Thallium, Dieldrin	2.14×10^{-7}	Beryllium
Inhalation of Volatiles from Soil	Not quantified[b]		Not quantified[b]	
Total Soil ILCR:			4.34×10^{-6}	

[a]Applies only to future scenario.
[b]Not quantified because no volatile organic compounds were detected in landfill soils.

5.4.4.2 Northwest Drainage System (SD-10)

Risk characterization results for SD-10 are presented in Appendix F.3 of the RI report and summarized in Table 5-30.

For the current and future residential scenarios, all pathways resulted in ILCRs less than the target risk range of 1 x 10^{-6} to 1 x 10^{-4} except for incidental ingestion of soil and inhalation of volatiles from soil, which resulted in ILCRs within this range. Primary contributors were beryllium and chloroform. No pathways resulted in HIs greater than 1.

Under the occupational scenario, inhalation of volatiles from soil resulted in ILCRs within the target risk range, primarily due to chloroform. No pathways resulted in ILCRs greater than that range or HIs greater than 1.

5.4.4.3 Radioactive Instrumentation Burial Area (RW-11)

The analytical results from RW-11 indicated that radium and uranium concentrations in soil near the two remaining footings ranged from 0.7 to 1.0 picoCuries per gram (pCi/g) of soil, which is consistent with the concentrations of radionuclides found naturally in Arizona surface soils (Myrick, et al. 1983).

In the event that an individual trespasses in RW-11, exposures may include incidental ingestion, dermal contact or inhalation of soil or dust from the area. Because significant disturbance of the soils would not be expected under a current land-use scenario, the primary exposure would involve surface soils rather than the subsurface soils near the buried concrete footings. The potential for exposures associated with future land-use conditions, however, cannot be excluded. The condition of the concrete footing and the actual contents of the footings have not been investigated. In the absence of these data, it was assumed that the footings would eventually deteriorate and release radionuclides into the soil. These conclusions are supported by a series of calculations that provide the basis for the estimated quantity of radium associated with RW-11 (IT, 1991c).

5.4.4.4 Pesticide Burial Area (DP-13)

Risk characterization results for DP-13 are presented in Appendix F.3 of the RI report and summarized in Table 5-31.

Table 5-30

Summary of Risk Characterization Results
Northwest Drainage System (SD-10)
Williams Air Force Base

Exposure Pathway	Total Hazard Index	Primary Contributor(s)	Total ILCR	Primary Contributor(s)
Current and Future Residential Scenarios				
Dermal Contact with Soil	1.26×10^{-2}	Bis(2-ethylhexyl)phthalate	2.80×10^{-7}	Bis(2-ethylhexyl)phthalate
Incidental Ingestion of Soil	2.12×10^{-1}	Antimony	4.51×10^{-6}	Beryllium
Inhalation of Fugitive Dust	4.62×10^{-4}	Antimony	1.39×10^{-7}	Beryllium, cadmium
Inhalation of Volatiles from Soil	1.02×10^{-2}	Chloroform	3.62×10^{-6}	Chloroform
Total Soil ILCR:			8.55×10^{-6}	
Current Occupational Scenario				
Dermal Contact with Soil	1.01×10^{-3}	Bis(2-ethylhexyl)phthalate, chloroform	1.02×10^{-7}	Bis(2-ethylhexyl)phthalate, chloroform
Incidental Ingestion of Soil	8.12×10^{-3}	Antimony	7.19×10^{-7}	Beryllium
Inhalation of Fugitive Dust	3.30×10^{-4}	Antimony	8.28×10^{-8}	Beryllium, cadmium
Inhalation of Volatiles from Soil	7.26×10^{-3}	Chloroform	2.15×10^{-6}	Chloroform
Total Soil ILCR:			3.05×10^{-6}	

Table 5-31

Summary of Risk Characterization Results
Pesticide Burial Area (DP-13)
Williams Air Force Base

Exposure Pathway	Total Hazard Index	Primary Contributor(s)	Total ILCR	Primary Contributor(s)
Current and Future Residential Scenarios				
Dermal Contact with Soil	5.21×10^{-4}	Bis(2-ethylhexyl)phthalate	1.21×10^{-8}	Bis(2-ethylhexyl)phthalate
Incidental Ingestion of Soil	3.93×10^{-1}	Antimony	1.27×10^{-9}	Bis(2-ethylhexyl)phthalate
Inhalation of Fugitive Dust	2.81×10^{-3}	Antimony	4.54×10^{-11}	Bis(2-ethylhexyl)phthalate
Inhalation of Volatiles from Soil	8.21×10^{-2}	Acetone	NA[a]	NA
Total Soil ILCR:			1.34×10^{-8}	
Current Occupational Scenario				
Dermal Contact with Soil	3.92×10^{-5}	Bis(2-ethylhexyl)phthalate	3.78×10^{-9}	Bis(2-ethylhexyl)phthalate
Incidental Ingestion of Soil	5.03×10^{-2}	Antimony	2.03×10^{-10}	Bis(2-ethylhexyl)phthalate
Inhalation of Fugitive Dust	2.01×10^{-3}	Antimony	2.70×10^{-11}	Bis(2-ethylhexyl)phthalate
Inhalation of Volatiles from Soil	5.86×10^{-2}	Acetone	NA	NA
Total Soil ILCR:			4.01×10^{-9}	

[a]NA - Not applicable; no volatile organic carcinogens were detected at this site.

For the current and future residential scenarios, and for the current occupational scenario, no pathways resulted in ILCRs greater than or within the target risk range of 1 x 10^{-6} to 1 x 10^{-4} or in HIs greater than 1.

5.4.4.5 Hazardous Materials Storage Area (SS-01)

Risk characterization results for SS-01 are presented in Appendix F.3 of the RI report and summarized in Table 5-32.

Under the current and future residential scenarios, incidental ingestion of soil and inhalation of fugitive dust resulted in ILCRs within the target risk range of 1 x 10^{-6} to 1 x 10^{-4}. Major contributors to risk were beryllium and cadmium. No pathways resulted in ILCRs greater than the target risk range or HIs greater than 1.

Under the occupational scenario, no pathways resulted in ILCRs greater than or within the target risk range or HIs greater than 1.

5.4.4.6 USTs at Building 789 (ST-05)

Risk characterization results for ST-05 are presented in Appendix F.3 of the RI report and summarized in Table 5-33. There were no carcinogens detected in ST-05, and for residential and occupational scenarios, no pathway resulted in an HI greater than 1.

5.4.4.7 USTs at Building 725 (ST-06)

Risk characterization results for ST-06 are presented in Appendix F.3 of the RI report and summarized in Table 5-34. There were no carcinogens detected in ST-06, and for residential and occupational scenarios, no pathway resulted in an HI greater than 1.

5.4.4.8 USTs at Building 1086 (ST-07)

Risk characterization results for ST-07 are presented in Appendix F.3 of the RI report and summarized in Table 5-35. For residential and occupational scenarios, no pathway resulted in an ILCR greater than or within the target risk range of 1 x 10^{-6} to 1 x 10^{-4} or a HI greater than 1. Methylene chloride (a possible laboratory contaminant) was the only chemical of potential concern in ST-07.

5.4.4.9 USTs at Building 1085 (ST-08)

Risk characterization results for ST-08 are presented in Appendix F.3 of the RI report and summarized in Table 5-36.

Table 5-32

Summary of Risk Characterization Results
Hazardous Materials Storage Area (SS-01)
Williams Air Force Base

Exposure Pathway	Total Hazard Index	Primary Contributor(s)	Total ILCR	Primary Contributor(s)
Current and Future Residential Scenarios				
Dermal Contact with Soil	1.07×10^{-3}	Methylene chloride	3.30×10^{-8}	Methylene chloride
Incidental Ingestion of Soil	2.97×10^{-2}	Copper	5.19×10^{-6}	Beryllium
Inhalation of Fugitive Dust	1.07×10^{-4}	Cadmium	1.61×10^{-6}	Cadmium
Inhalation of Volatiles from Soil	1.65×10^{-4}	Methylene chloride	8.68×10^{-8}	Methylene chloride
Total Soil ILCR:			6.92×10^{-6}	
Current Occupational Scenario				
Dermal Contact with Soil	8.08×10^{-5}	Methylene chloride, ethyl benzene	1.04×10^{-8}	Methylene chloride
Incidental Ingestion of Soil	1.14×10^{-3}	Copper	8.28×10^{-7}	Beryllium
Inhalation of Fugitive Dust	1.14×10^{-4}	Cadmium	9.6×10^{-7}	Cadmium
Inhalation of Volatiles from Soil	1.18×10^{-4}	Methylene chloride	5.17×10^{-8}	Methylene chloride
Total Soil ILCR:			1.85×10^{-6}	

Table 5-33

Summary of Risk Characterization Results
Building 789 USTs (ST-05)
Williams Air Force Base

Exposure Pathway	Total Hazard Index	Primary Contributor(s)	Total ILCR	Primary Contributor(s)
Future Residential Scenario				
Dermal Contact with Soil	3.23×10^{-3}	Ethyl benzene	NA[a]	NA
Incidental Ingestion of Soil	6.30×10^{-4}	Ethyl benzene	NA	NA
Inhalation of Fugitive Dust	2.27×10^{-5}	Xylenes	NA	NA
Inhalation of Volatiles from Soil	1.18×10^{-3}	Xylenes	NA	NA
Current Occupational Scenario				
Dermal Contact with Soil	2.43×10^{-4}	Ethyl benzene	NA	NA
Incidental Ingestion of Soil	2.41×10^{-5}	Ethyl benzene	NA	NA
Inhalation of Fugitive Dust	1.62×10^{-5}	Xylenes	NA	NA
Inhalation of Volatiles from Soil	8.46×10^{-4}	Xylenes	NA	NA

[a]NA - Not applicable; no carcinogenic chemicals of potential concern were found at this site.

Table 5-34

Summary of Risk Characterization Results
Building 725 USTs (ST-06)
Williams Air Force Base

Exposure Pathway	Total Hazard Index	Primary Contributor(s)	Total ILCR	Primary Contributor(s)
Future Residential Scenario				
Dermal Contact with Soil	3.79×10^{-5}	Ethyl benzene	NA[a]	NA
Incidental Ingestion of Soil	7.24×10^{-6}	Ethyl benzene	NA	NA
Inhalation of Fugitive Dust	1.24×10^{-8}	Xylenes	NA	NA
Inhalation of Volatiles from Soil	2.34×10^{-6}	Xylenes	NA	NA
Current Occupational Scenario				
Dermal Contact with Soil	2.85×10^{-6}	Ethyl benzene	NA	NA
Incidental Ingestion of Soil	2.77×10^{-7}	Ethyl benzene	NA	NA
Inhalation of Fugitive Dust	5.28×10^{-9}	Xylenes	NA	NA
Inhalation of Volatiles from Soil	1.68×10^{-6}	Xylenes	NA	NA

[a]NA - Not applicable; no carcinogenic chemicals of potential concern were found at this site.

Table 5-35

Summary of Risk Characterization Results
Building 1086 USTs (ST-07)
Williams Air Force Base

Exposure Pathway	Total Hazard Index	Primary Contributor(s)	Total ILCR	Primary Contributor(s)
Future Residential Scenario				
Dermal Contact with Soil	5.63×10^{-6}	Methylene chloride	2.17×10^{-10}	Methylene chloride
Incidental Ingestion of Soil	1.66×10^{-6}	Methylene chloride	6.41×10^{-11}	Methylene chloride
Inhalation of Fugitive Dust	8.28×10^{-10}	Methylene chloride	5.04×10^{-13}	Methylene chloride
Inhalation of Volatiles from Soil	7.64×10^{-7}	Methylene chloride	4.63×10^{-10}	Methylene chloride
Total Soil ILCR:			7.45×10^{-10}	
Current Occupational Scenario				
Dermal Contact with Soil	5.94×10^{-7}	Methylene chloride	9.55×10^{-11}	Methylene chloride
Incidental Ingestion of Soil	6.36×10^{-8}	Methylene chloride	1.02×10^{-11}	Methylene chloride
Inhalation of Fugitive Dust	5.92×10^{-10}	Methylene chloride	3.00×10^{-13}	Methylene chloride
Inhalation of Volatiles from Soil	5.46×10^{-7}	Methylene chloride	2.76×10^{-10}	Methylene chloride
Total Soil ILCR:			3.82×10^{-10}	

Table 5-36

Summary of Risk Characterization Results
Building 1085 USTs (ST-08)
Williams Air Force Base

Exposure Pathway	Total Hazard Index	Primary Contributor(s)	Total ILCR	Primary Contributor(s)
Future Residential Scenario				
Dermal Contact with Soil	8.5×10^{-4}	Bis(2-ethylhexyl)phthalate	1.90×10^{-8}	Bis(2-ethylhexyl)phthalate
Incidental Ingestion of Soil	1.42	Antimony	2.00×10^{-9}	Bis(2-ethylhexyl)phthalate
Inhalation of Fugitive Dust	3.03×10^{-3}	Antimony	2.29×10^{-7}	Cadmium
Inhalation of Volatiles from Soil	6.77×10^{-3}	Acetone	NA[a]	NA
Total Soil ILCR:			2.50×10^{-7}	
Current Occupational Scenario				
Dermal Contact with Soil	6.40×10^{-5}	Bis(2-ethylhexyl)phthalate	5.95×10^{-9}	Bis(2-ethylhexyl)phthalate
Incidental Ingestion of Soil	1.63×10^{-2}	Antimony	3.18×10^{-10}	Bis(2-ethylhexyl)phthalate
Inhalation of Fugitive Dust	2.23×10^{-3}	Antimony	1.36×10^{-7}	Cadmium
Inhalation of Volatiles from Soil	4.83×10^{-3}	Acetone	NA	NA
Total Soil ILCR:			1.42×10^{-7}	

[a]NA - Not applicable; no volatile organic carcinogens were detected at this site.

For the future residential scenario, no pathway resulted in an ILCR greater than or within the target risk range of 1×10^{-6} to 1×10^{-4}. Incidental ingestion of soil resulted in an HI greater than 1, primarily due to antimony.

Under the occupational scenario, no pathways resulted in ILCRs within or greater than the target risk range or HIs greater than 1.

5.4.5 Uncertainties

A risk assessment of a site is ultimately an integrated evaluation of historical, chemical, analytical, environmental, demographic, and toxicological data that are as site-specific as possible. In order to present a conservative evaluation, each step is biased toward health protective estimations. In addition, these calculations do not represent currently existing or expected future exposure or health risks. They are estimates of potential risk only if all of the conservative assumptions are realized. As discussed in the exposure assessment, this risk assessment does not represent a worst-case scenario; therefore, the potential for under-estimating some risks to some receptors does exist.

The reported levels of antimony are expected to be one to two orders of magnitude higher than actual concentrations as a result of inaccurate laboratory calculations; therefore, the risk characterization results with respect to antimony should be considered preliminary and may change significantly as the data are updated.

5.4.5.1 Updated Risk Assessment

Based on the recommendations of the OU-1 RI report, additional surface soil samples were collected in September 1993 to establish Base-specific background inorganic levels. Nine samples and one duplicate were collected in accordance with an approved OU-1 Field Sampling Plan Addendum (IT, 1993b) and the analytical results were used to determine a Base-specific background range in surface soils for each metal. These ranges are presented in Table 4-1. As shown in this table, the Base-specific background ranges are within the regional ranges and are comparable; therefore, use of the regional ranges for background values for inorganics to perform the risk assessment was appropriate.

During preparation of an Addendum to the OU-1 RI report, the risk assessments for OU-1 sites were rerun to determine any potential impact of the use of Base-specific background values on the final outcome of the risk assessment. It was determined at the time to keep all other criteria constant; that is, the guidance and toxicity values that were in place at the time of the initial risk assessment were utilized rather than updating the entire risk assessment to reflect current guidance, practices, and toxicity values. The reevaluation of the risk assessment on that basis resulted in selecting several additional inorganics as chemicals of potential concern that were initially not selected and risks being evaluated for those additional inorganics. Results of those risk assessment evaluations are presented for each OU-1 site that required modification in the addendum to the OU-1 RI report (IT, 1994b) and results for all OU-1 sites are summarized in Appendix A.1 of this ROD. The following are the major differences between the initial and reevaluation of the risk assessment:

- Fire Protection Training Area No. 1, which had previously not been addressed in the risk assessment process, has risks quantified for it.
- Lead required evaluation for risk due to its inclusion as a chemical of potential concern. Lead was excluded from the initial risk assessment based on regional background values. When the risk assessment was initially run, there was guidance in place that allowed for the quantification of risks due to lead. This is no longer true by current (1994) guidance practices, i.e., there are no EPA-approved toxicity values for lead. However, in an attempt to keep the basis of the risk assessments consistent, risks due to lead at the appropriate sites were quantified.
- A construction worker scenario was added for the UST sites (ST-05, ST-06, ST-07, and ST-08) to evaluate a shorter exposure duration occupational worker. This is in response to some comments raised by the reuse group concerning potential reuse scenarios that were initially not considered. Evaluations did not show any unacceptable risks to human health under this scenario.

Although the quantified risk values for HIs and ILCRs had minor changes for the various sites, the overall results of the risk assessment resulted in no additional chemicals of potential concern with risk estimates above acceptable health levels for any OU-1 site.

Below is a summary of all human health risks from the reevaluation for each site. All HIs above one or ILCRs greater than the target risk range of 1×10^{-6} to 1×10^{-4} are noted:

- Landfill (LF-04)
  - HI=6.71, Ingestion of Groundwater, Future Resident, Primary Contributors - antimony and chromium
  - HI=1.21, Incidental Ingestion of Soil, Current and Future Resident, Primary Contributor - lead
  - No ILCRs above 1×10^{-4}

- Fire Protection Training Area No. 1 (FT-03)
  - HI=1.37, Incidental Ingestion of Soil, Current and Future Resident, Primary Contributor - antimony
  - No ILCRs above 1 x 10^{-4}

- Northwest Drainage System (SD-10)
  - No HIs above 1
  - No ILCRs above 1 x 10^{-4}

- Pesticide Burial Area (DP-13)
  - No HIs above 1
  - No ILCRs above 1 x 10^{-4}

- Hazardous Materials Storage Area (SS-01)
  - No HIs above 1
  - No ILCRs above 1 x 10^{-4}

- USTs (ST-05)
  - No HIs above 1

- USTs (ST-06)
  - No HIs above 1

- USTs (ST-07)
  - No HIs above 1
  - No ILCRs above 1 x 10^{-4}

- USTs (ST-08)
  - No HIs above 1
  - No ILCRs above 1 x 10^{-4}.

5.4.5.2 EPA Evaluation of Risk Assessment

On February 7, 1994, EPA Region IX issued a memorandum concerning an independent evaluation of the risks associated with the OU-1 sites at Williams AFB, which is included in this document for reference purposes as Appendix A.2. In that memorandum, EPA compared the concentrations of metals that were not initially considered in the risk assessment to EPA Region IX PRGs, and calculated a cancer and noncancer risk from each metal. In addition, risks were calculated for metals whose concentrations exceeded EPA's PRGs even if the values were within regional background levels. Those risk values were then added to the risks calculated during the risk assessment presented in the OU-1 RI Report to yield an estimated cumulative risk. As part of the EPA's conservative approach, a residential scenario was utilized. Furthermore, the highest detected concentrations were used in the risk calculations, regardless of the depth at which they were detected and whether or not those soils had been removed during removal or response action.

The conclusion of EPA's evaluation was that, based on all available data, the remedies proposed for OU-1 sites are valid. This independent evaluation not only confirmed that the risks calculated in both the RI Report and the RI Report Addendum are valid, but that the risks from OU-1 site contaminants are acceptable when compared against current EPA guidance and practices.

5.5 Ecological Risk Assessment

An ecological risk assessment of the Base was performed by IT in 1993. The following text is summarized from the Baseline Ecological Risk Assessment: Operable Unit-3 - Basewide report (IT, 1993c).

5.5.1 Objectives

The main objective of this Ecological Risk Assessment was to assess the potential risk of particular contaminants upon the ecosystems present at 13 study sites located primarily in the western half of Williams AFB: Pesticide Burial Area (DP-13), Fire Protection Training Area No. 2 (FT-02), Fire Protection Training Area No. 1 (FT-03), Landfill (LF-04), Radioactive Instrumentation Burial Area (RW-11), Southwest Drainage System (SD-09), Northwest Drainage System (SD-10), Hazardous Materials Storage Area (SS-01), Building 789 USTs (ST-05), Building 725 USTs (ST-06), Building 1086 USTs (ST-07), Building 1085 USTs (ST-08), and Liquid Fuels Storage Area (ST-12). This ecological assessment evaluated potential adverse impacts associated with estimated exposure concentrations relative to maximum acceptable exposure concentrations for selected ecological receptors at these sites. A weight-of-evidence approach, including site-specific observations of vegetative cover, live-trapping to characterize small mammal populations, extensive evaluation of the ecological and toxicological literature, food web modeling of exposure point concentrations, and chemical analysis of chemicals of concern levels in animal and plant tissues, was used to estimate risks posed by site-related contaminants to selected ecological receptors. This assessment was designed to be conservative and is likely to overestimate actual receptor exposure levels. Therefore, risk characterization may indicate that an ecological receptor is at risk from exposure to a contaminant, when in fact no actual impact has occurred or is occurring. The conclusions that follow address only the affected OU-1 sites and exclude FT-02, SD-09, and ST-12.

5.5.2 Conclusions

A summary of problem formulation results for all OU-1 sites appears in Table 5-37. Conceptual modeling segregated study sites into two groups: those requiring further risk characterization and those lacking one or more of the components required for exposure to occur.

Study site RW-11 was excluded from further consideration due to a lack of identified chemicals of concern and complete exposure pathways. Study site SS-01 was excluded due to a lack of potential receptors. Study sites ST-05, ST-06, ST-07, and ST-08 were excluded due to a lack of complete exposure pathways and ecological receptors. Although study sites FT-03 and SD-10 have chemicals of concern, receptors, and complete pathways, on-going maintenance mowing has a greater adverse impact on ecological receptors than the limited number of chemicals of concern present at these sites. These sites were excluded from further consideration for this reason.

It was determined that invertebrate and vertebrate receptors extant in, near or transiting study sites DP-13 and LF-04 could be experiencing acute or chronic toxic effects due to contaminants in soils or surface water. These sites were carried forward for risk characterization.

5.5.2.1 Pesticide Burial Area (DP-13)

At DP-13, sources of all chemicals of concern have been removed. The pesticides detected have a potential to bioaccumulate from abiotic media and food items to levels harmful to higher trophic level receptors. However, the frequency of detection was only 5 percent for both DDE and dieldrin, suggesting that the extent of contamination, and thus opportunities for exposure, is low.

Information obtained from the weight-of-evidence approach suggests that bioaccumulation or biomagnification has not been occurring to the extent that harmful chemicals of concern levels were reached in indicator species. No estimated dietary concentrations of chemicals of concern exceeded acceptable levels for any indicator species. Chemical analyses did not identify significant differences in cotton rat, woodrat, or plant tissue levels of antimony, dieldrin, or 4,4'-DDE between samples collected near DP-13 and at a reference area. No adverse effects were observed directly during the site surveys.

Table 5-37

Summary of Problem Formulation Results for OU-1 Sites

STUDY SITE	COCs PRESENT?	RECEPTORS AVAILABLE?	COMPLETE EXPOSURE PATHWAYS?	COMMENTS/ RECOMENDATIONS
DP-13	yes	yes	yes	numerous potential receptors present; COCs include pesticides; further risk characterization required
FT-03	few	yes	yes	limited number of COCs; on-going mechanical stress (mowing); exclude from further consideration
LF-04	yes	yes	yes	numerous potential receptors present; COCs include pesticides; further risk characterization required
RW-11	no	yes	no	removal and closure actions complete; no COCs present; exclude from further consideration
SD-10	few	yes	yes	limited number of COCs; on-going mechanical stress (mowing); exclude from further consideration
SS-01	yes	no	yes	source removal complete; lacks habitat for receptors; exclude from further consideration
ST-05 ST-06 ST-07 ST-08	few	no	no	removal and closure actions complete; no COCs present at surface; lacks habitat for receptors; exclude from further consideration

Based on the data presented, and taking into consideration the uncertainties inherent in this assessment, the probability for adverse ecological effects occurring at DP-13 was judged to be not significant. It can be concluded that alteration of habitat by direct mechanical stresses has had a more profound effect on this site than the chemicals of concern. This area has been remediated, and no further action is recommended.

5.5.2.2 Landfill (LF-04)

LF-04 is utilized by burrowing animals (primarily ground squirrels, rabbits, and rodents) living in intimate contact with contaminated soils. This type of contact facilitates the potential for bioaccumulation and subsequent biomagnification is of particular concern with regards to rodent predators such as raptors and coyotes. Information obtained from weight-of-evidence methods suggests that actual intake is not occurring to the extent that harmful chemicals of concern levels were being reached in the indicator species.

Chemical analyses did not identify significant differences in tissue levels of any metal or pesticide between cotton rat, woodrat, or plant tissue samples collected at LF-04 and at a reference area. Detectable levels of 4,4'-DDE were found in plant tissues collected at LF-04 but not at levels statistically different from a reference area. It is not possible to completely exclude the possibility that small, isolated pesticide "hot spots" exist within or near LF-04. Whether any such hot spots might be due to site-related activities or from off-site agricultural operations would be difficult to determine. No adverse effects were observed directly during the site surveys.

When evaluating whether pentachlorophenol concentrations pose an unacceptable risk to the coyote and desert cottontail, ecological, as well as toxicological, factors should be taken into consideration. For example, actual intake is strongly influenced by an animal's mobility (the cottontail feeds in a foraging range of approximately 14.4 acres; the coyote's foraging range is approximately 1,162 acres, which takes in areas other than the landfill). As a result, these species may spend only a small proportion of their time actually foraging on the landfill.

Based on the data presented, and taking into consideration the uncertainties inherent in this assessment, the probability for adverse ecological effects occurring at LF-04 are judged to be not significant. However, because of uncertainty regarding pesticide levels, it is suggested that some measures be taken to limit burrowing animal access to landfill materials. It can be concluded that alteration of habitat by direct mechanical stresses has had a more profound effect on this site than the chemicals of concern.

5.5.2.3 Conclusion Summary

Based on all available information at this time and taking into account the uncertainties addressed in the Baseline Ecological Risk Assessment and summarized in this section, all of the OU-1 sites do not pose significant ecological risk.

5.6 Selection of Chemicals Requiring Remedial Action

To determine which chemicals of potential concern found in OU-1 groundwater and soils required the evaluation and application of remedial technologies, media-specific criteria were developed. This determination identified which chemicals or metals would require remediation to meet remediation goals. In performing this determination, the concentrations of chemicals/metals used were the 95 percent UCL concentrations defined during the risk assessment. A sample UCL concentration calculation is presented in Appendix H to the OU-1 FS report.

The groundwater criteria for determining chemicals/metals requiring remedial action to meet remediation goals are as follows:

- Each chemical/metal with a upper confidence limit (UCL) concentration that did not exceed the remediation goal based on the applicable or relevant and appropriate requirements (ARAR), criteria to be considered (TBC) such as risk-based criteria, and maximum background values, was determined to not require remedial action.

- Each chemical/metal resulting from well construction material as explained in Appendix D of the FS report was eliminated because the associated data points do not represent the concentrations of these chemicals/metals (i.e., nickel, chromium, and zinc) in the aquifer.

- Each chemical/metal with a UCL concentration and remediation goal below the detection limit was eliminated when there were no detections of the chemical/metal.

- Each chemical/metal with a UCL concentration above the respective limit but whose presence was due to activities external to OU-1 was determined to not require remedial action. This criterion relates directly to nitrate levels as explained in Appendix E of the FS report.

The soil criteria for determining chemicals/metals requiring remedial action to meet measurable remediation goals are as follows:

- Each chemical/metal with an UCL concentration that did not exceed the remediation goal based on risk-based TBCs was determined not to require remedial action.

- Each chemical/metal with a UCL concentration equivalent to or below background was determined not to require remedial action.

- Each chemical/metal with a UCL concentration and remediation goal below the detection limit was eliminated when there were no detections of the chemical/metal.

- Each chemical/metal with a UCL concentration above the respective remediation goal but whose presence was determined to not be contamination in soil was determined not to require remedial action. This criterion relates directly to the presence of several chemicals/metals that were determined to be laboratory or sample collection related as explained in Section 1.3 of the OU-1 FS report.

Additional sampling was conducted in September 1993 to determine site-specific background concentrations for inorganic constituents in soils. These values, presented in Table 4-1, confirm and supplement the previously used U.S. Geological Survey (USGS) regional soils data.

Sections 5.6.1 through 5.6.10 summarize the site-specific selection process for chemicals requiring treatment and present a rationale for excluding some chemicals from consideration in the remedial response process. This analysis provides the basis for conclusions about the need to implement remedial actions at each site.

5.6.1 Landfill (LF-04)

5.6.1.1 Groundwater

The summary of this determination is presented in Table 5-38. The UCL concentration of six chemicals/metals in the LF-04 groundwater samples were above the known maximum background values and remediation goals selected in Appendix B: benzene, bis(2-ethylhexyl) phthalate, antimony, chromium, nickel, and nitrate. The chromium and nickel detected is attributed to well construction materials and sampling methodology. The October 1993 24-hour purge test confirmed that the elevated levels of nickel and chromium previously detected are not representative of the quality of the aquifer at LF-04, and therefore, remedial action is not presently required for groundwater. A detailed discussion of the chromium and nickel issue is presented in Appendix D of the OU-1 FS report.

Table 5-38

Determination of Remedial Action for Chemicals of Potential Concern
LF-04 Groundwater
Williams Air Force Base

Chemicals of Potential Concern	Range or Value of Detection Limits (µg/L)	Background Range or Value (µg/L)	RG (µg/L)	UCL[a] Concentration (µg/L)	Basis for No Further Action
Acetone	10	NA[b]	700	7.3	UCL concentration is below RG
Benzene	0.5-50	NA	5.0	17	UCL concentration and RG within detection limit range; only one value above detection limit at Well LA-04; remaining LA-04 benzene values were nondetects
Bis(2-Ethylhexyl) phthalate	4.0-30	NA	6.0	10	UCL concentration and RG are within detection limit range. The three values above detection limit originate from early non-validated analyses. Recent sampling has not confirmed the higher values.
Bromide	900	NA	NA	1041	No toxicity information available for developing an RG for this compound
Bromodichloromethane	0.5-5.0	NA	100	0.44	UCL concentration is below RG
Carbon disulfide	5.0	NA	700	3.4	UCL concentration is below RG
Methylene chloride	0.5-26	NA	5.0	5.6	All concentrations above RG originate from early non-validated analyses. UCL concentration is equal to RG; common laboratory contaminant. Recent sampling has not confirmed the higher values.
Tetrachloroethene	0.5-5.0	NA	5.0	0.85	UCL concentration is below RG
Toluene	0.5-25	NA	1000	1.1	UCL concentration is below RG
Trichloroethene	0.5-5.0	NA	3.2	0.54	UCL concentration is below RG
Antimony	18-60	NA	6.0	23	RG below detection limit; only one value above detection limit range at Well W-12; remaining W-12 values were nondetects

Table 5-38

(Page 2 of 2)

Chemicals of Potential Concern	Range or Value of Detection Limits (µg/L)	Background Range or Value (µg/L)	RG (µg/L)	UCL[a] Concentration (µg/L)	Basis for No Further Action
Beryllium	0.3-5.0	<1.0-7.0	<1.0-7.0	1.3	UCL concentration is within RG range
Cadmium	2.0-5.0	<1.0	5.0	3.0	UCL concentration is below RG
Chromium (Total)	3.0-10	<1.0-12	100	566	Concentrations attributed to well construction materials and sampling methodology. Highest concentrations detected upgradient of landfill.
Copper	2.0-30	10-30	1300	18	UCL concentration is below the RG and is within background range
Lead	1.0-40	10-14	15	9.6	UCL concentration is below the RG and is within background range
Manganese	1.0-20	<1.0-20	700	60	UCL concentration is below the RG
Nickel	7.0-40	NA	100	556	Concentrations attributed to well construction materials and sampling methodology. Highest concentrations detected upgradient of landfill.
Nitrate (as N)	50-600	1,470-33,800	10,000	31,460	UCL concentration within background range; elevated levels not due to landfill activities, extensive agricultural activities surround Base
Selenium	1.0-200	ND-3.0	50	1.9	UCL concentration is below RG and is within background range
Silver	3.0-70	NA	50	6.6	UCL concentration is below RG
Zinc	2.0-20	<3.0-38	1400	465	UCL concentration is below RG
Uranium	0.0015	NA	20	0.0036	UCL concentration is well below RG

[a]UCL - Arithmetic mean of concentrations detected plus two standard deviations (95% confidence level)
[b]NA - Not available or not used for comparison

All except one value reported for benzene was below the remediation goal. This value of 380 µg/L was detected at Well LA-04 in December 1990. Subsequent analyses from other samples from this well in later sampling rounds did not detect benzene. This one data point, therefore, does not represent the water quality in the aquifer at LA-04 and benzene was determined to not require remedial action to meet remediation goals.

One bis(2-ethylhexyl)phthalate value of 10 µg/L was reported from Well LA-03 in May 1991. All other values reported for this well were below the remediation goal. Bis(2-ethylhexyl)-phthalate concentrations of 15 µg/L and 16 µg/L were reported at Well LA-01 in May 1991 and January 1992, respectively. All other values reported for this well were below the remediation goal. One value of 150 µg/L was reported at Well LA-04 in July 1989. All other values reported for this well were below the detection limit. These three values detected at these three wells, thus, do not characterize the aquifer near those wells. Bis(2-ethylhexyl)phthalate was, therefore, determined to not require remedial action to meet remediation goals.

All values except one for antimony were below the detection limit. This value of 106 µg/L was detected in the shallow aquifer at upgradient Well LF01-W-12 in October 1991. All of the remaining analyses on samples from this well both before and after October 1991 sample did not detect antimony. This one sample, therefore, does not characterize the aquifer near the well. Antimony, therefore, was determined to not require remedial action to meet remediation goals.

As stated in Appendix E of the OU-1 FS report, the nitrate detected in groundwater was determined not to be related to landfill activities. Levels detected are within background range established in Appendix E of the OU-1 FS report. Therefore, nitrate was determined not to require remediation to meet remediation goals.

Consequently, based on this evaluation of data related to all chemicals of potential concern found in the LF-04 groundwater and summarized in Table 5-38, the groundwater within the vicinity of LF-04 does not require remediation to meet remediation goals and no further action is required. Quarterly sampling rounds will continue to monitor for the chemicals of potential concern until the selected remedy is implemented. Upon completion of the remedial action, long-term groundwater monitoring will be conducted on a semiannual basis (every 6 months).

5.6.1.2 Soils

The summary of this determination is presented in Table 5-39. The UCL concentrations of two constituents (beryllium and dieldrin) in the LF-04 soil samples were above the remediation goals. Beryllium was detected in all ten samples collected and the UCL concentration is above the remediation goal of 1.5 mg/kg presented in Appendix B. Dieldrin was detected in eight of ten samples taken of surface soil samples at LF-04. The resulting UCL concentration is 0.105 mg/kg, which is above the remediation goal of 0.02 mg/kg as presented in Appendix B. Therefore, remedial action is required at LF-04 to address the health risks associated with beryllium and dieldrin contamination in surface soil.

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

5.6.2 Fire Protection Training Area 1 (FT-03)

This section is based on information discussed in Section 5.4.5 and Appendix A.1.

5.6.2.1 Groundwater

The summary of this determination is presented in Table 5-40. The UCL concentrations of all chemicals/metals, expect zinc, in the FT-03 groundwater samples were below the remediation goals in Appendix B.

Zinc was detected in three samples analyzed for this metal at concentrations from 780 to 1,600 µg/L with a UCL concentration of 1,655 µg/L, which is not significantly above the groundwater remediation goals for zinc. The elevated levels of zinc are attributed to well construction materials and are not representative of groundwater quality at FT-03 and no unacceptable risks are present under any scenario for this metal. This issue was discussed in the FS report.

5.6.2.2 Soils

The summary of this determination is presented in Table 5-41. The UCL concentration of all chemicals/metals in the FT-03 soil samples were below the remediation goals in Appendix B, except for antimony.

Three surface soil samples were collected and analyzed for VOCs, SVOCs, and primary pollutant metals during confirmatory sampling conducted in September 1993. The analytical

Table 5-39
Determination of Remedial Action for Chemicals of Potential Concern
LF-04 Surface Soils
Williams Air Force Base

Chemical of Potential Concern	Range or Value of Detection Limits (mg/kg)	Background Range or Value (mg/kg)	RG (mg/kg)	UCL[a] Concentration (mg/kg)	Basis for No Further Action
Alpha-chlordane	0.0018-0.0072	NA	0.25	0.0025	UCL concentration is below RG
Beta-BHC	0.0018-0.0072	NA	0.18	0.0041	UCL concentration is below RG
Bis(2-ethylhexyl) phthalate	0.35-3.5	NA	22.9	0.613	UCL concentration is below RG
4,4'-DDD	0.0035-0.014	NA	1.34	0.0072	UCL concentration is below RG
4,4'-DDE	0.0035-0.014	NA	0.94	0.064	UCL concentration is below RG
4,4'-DDT	0.0035-0.014	NA	0.94	0.067	UCL concentration is below RG
1,4-Dichlorobenzene	0.33-3.5	NA	13.4	0.673	UCL concentration is below RG
Dieldrin	0.0035-0.014	NA	0.02	0.105	Requires remedial action to meet RG
Di-n-butylphthalate	0.35-3.5	NA	2,330	0.67	UCL concentration is below RG
Diethyl phthalate	0.35-3.5	NA	22,000	0.68	UCL concentration is below RG
Gamma-chlordane	0.0018-0.0072	NA	0.25	0.0025	UCL concentration is below RG
Pentachlorophenol	0.85-8.5	NA	2.67	1.666	UCL concentration is below RG
1,2,4-Trichlorobenzene	0.33-3.5	NA	35.7	0.679	UCL concentration is below RG
Arsenic	2.0	2.3-4.3	78	5.2	UCL concentration is below RG
Beryllium	1.0	1.0-1.6	1.0-1.6	2.8	Requires remedial action to meet RG
Cadmium	0.83-1.0	ND (<1)	14	0.84	UCL concentration is below RG
Chromium	2.0	16.9-24.8	390	23	UCL concentration is below RG
Lead	0.6	10.4-19.4	55	54	UCL concentration is below RG
Nickel	8.0	15.6-24.7	1,600	22	UCL concentration is below RG
Thallium	0.2-2.0	ND (<2)	5.48	0.17	UCL concentration is below RG
Zinc	4.0	ND (<4)	15,600	116	UCL concentration is below RG

NA=not available or not used for comparison.
[a]UCL = arithmetic mean of concentrations plus two standard deviations (95% confidence level).

Table 5-40

Determination of Remedial Action for Chemicals of Potential Concern
FT-03 Groundwater
Williams Air Force Base

Chemicals of Potential Concern	Range or Value of Detection Limits (µg/L)	Background Range or Value (µg/L)	RG (µg/L)	UCL[a] Concentration (µg/L)	Basis for No Further Action
Acetone	10.0	NA	700	5.60	UCL concentration is below RG
Carbon disulfide	5.0	NA	700	2.80	UCL concentration is below RG
Methylene chloride	0.5-5.0	NA	5	2.71	UCL concentration is below RG
Toluene	1.0-5.0	NA	1,000	1.57	UCL concentration is below RG
Cadmium	5.0	<1.0	5.0	4.67	UCL concentration is below RG
Lead	1.0-5.0	<10.0-14.0	15	6.78	UCL concentration is below RG
Zinc	20.0	<3.0-38	1,400	1,655	Concentration is attributable to well construction materials, and not representative of aquifer. No unacceptable risks present for this compound under any scenario.

NA=not available or not used for comparison.
[a]UCL=arithmetic mean of concentrations plus two standard deviations (95% confidence level).

Table 5-41

Determination of Remedial Action for Chemicals of Potential Concern
FT-03 Soils
Williams Air Force Base

Chemical of Potential Concern	Range or Value of Detection Limits (mg/kg)	Background Range or Value (mg/kg)	RG (mg/kg)	UCL[a] Concentration (mg/kg)	Basis for No Further Action
Acetone	0.01	NA	5,490	0.007	UCL concentration is below RG
Bis(2-ethylhexyl)phthalate	0.33	NA	22.9	0.324	UCL concentration is below RG
1,2-Dichlorobenzene	0.33-1.0	NA	2,470	0.603	UCL concentration is below RG
1,3-Dichlorobenzene	0.33-1.0	10,000	10,000	0.663	UCL concentration is below RG
1,4-Dichlorobenzene	0.33-1.0	NA	13.4	0.703	UCL concentration is below RG
Methylene chloride	0.005-2.0	NA	1.86	1.88	UCL concentration is equivalent to RG
Methyl ethyl ketone	0.010-10	NA	742	4.87	UCL concentration is below RG
Phenol	0.33	NA	16,500	0.176	UCL concentration is below RG
Antimony	0.06	ND (<12)	31.3	34.11	September 1993 soil sampling confirms that antimony is not present in surface soil. See Section 1.3.3.1
Cadmium	0.005	ND (<1)	14	1.82	UCL concentration is below RG
Lead	0.003-10	10.4-19.4	55	12.3	UCL concentration is below RG
Silver	0.01	ND (<2)	235	3.84	UCL concentration is below RG
Zinc	0.02	ND (<4)	15,600	58.16	UCL concentration is below RG

NA=not available or not used for comparison
[a]UCL=arithmetic mean of concentrations plus two standard deviations (95% confidence level).

results confirm that the isolated detections of antimony in early 1989 were analytical anomalies, and therefore antimony is not a concern at this site.

5.6.3 Northwest Drainage Ditch (SD-10)

5.6.3.1 Groundwater

Groundwater at this site was not monitored because there was no indication or evidence of a pathway to groundwater from suspect soils. Therefore, chemicals of potential concern for SD-10 groundwater do not require identification.

5.6.3.2 Soils

The summary of this determination is presented in Table 5-42. The UCL concentrations of all chemicals/metals, except chloroform, in the SD-10 soil samples were below the remediation goals presented in Appendix B. Chloroform was detected only in the 1986 AV Stage 2 boring samples. These 1986 data were not validated. Chloroform was not detected during the 1989 confirmatory sampling that was initiated due to a wide range of organic contaminants detected during the AV sampling activities. Based on the new data, the unvalidated 1986 data do not appear to represent any chloroform contamination in the SD-10 soils, and remediation of SD-10 soils to meet remediation goals for chloroform is unwarranted.

5.6.4 Radioactive Instrumentation Burial Area (RW-11)

No further action is required at this site because a removal action completed in December 1992 eliminated the source of potential contamination. Confirmatory soil sampling and analysis has verified that levels of radioactivity are within background ranges. Groundwater at this site was not monitored because there was no indication or evidence of a pathway to groundwater from suspect soils. Therefore, chemicals of potential concern for RW-11 groundwater do not require identification.

5.6.5 Pesticide Burial Area (DP-13)

5.6.5.1 Groundwater

Groundwater at this site was not monitored because there was no indication or evidence of a pathway to groundwater from suspect soils. Therefore, chemicals of potential concern for DP-13 groundwater do not require identification.

Table 5-42

Determination of Remedial Action for Chemicals of Potential Concern
SD-10 Soils
Williams Air Force Base

Chemicals of Potential Concern	Range or Value of Detection Limits (mg/kg)	Background Range or Value (mg/kg)	RG (mg/kg)	UCL[a] Concentration (mg/kg)	Basis for No Further Action
Acetone	0.01	NA	5,490	0.018	UCL concentration is below RG
Bis(2-ethylhexyl)phthalate	0.34-0.73	NA	22.9	5.89	UCL concentration is below RG
Chloroform	0.005-1.0	NA	0.22	0.74	Data not representative; only detected in non-validated 1986 sampling round and not in subsequent confirmatory sampling round in 1989
Methylene chloride	0.005-1.0	NA	5.5	1.38	UCL concentration is below RG
Phenol	0.001-0.73	NA	16,500	0.171	UCL concentration is below RG
Toluene	0.005-2.0	NA	11,000	0.85	UCL concentration is below RG
Antimony	1.0-1.5	ND (<12)	31.3	6.1	UCL concentration is below RG
Arsenic	2.0-3.0	2.3-4.3	78	1.7	UCL concentration is below RG
Beryllium	0.01-2.0	1.0-1.6	1.0-1.6	0.95	UCL concentration is below RG
Cadmium	0.4-2.0	ND (<1)	14.0	0.61	UCL concentration is below RG
Chromium	0.7-2.0	16.9-24.8	390	19	UCL concentration is below RG
Copper	0.6-5.0	ND (<5)	2,900	1	UCL concentration is below RG
Lead	1.0-4.0	10.4-19.4	55	19	UCL concentration is below RG
Mercury	0.1-0.2	ND (<0.2)	23.5	0.08	UCL concentration is below RG
Nickel	2.0-11	15.6-24.7	1,600	16	UCL concentration is below RG
Silver	0.7-3.0	ND (<2)	235	1.3	UCL concentration is below RG
Zinc	0.2-4.0	ND (<4)	15,600	85.21	UCL concentration is below RG

NA=not available or not used for comparison
[a]UCL=arithmetic mean of concentrations plus two standard deviations (95% confidence level).

5.6.5.2 Soils

No further action is required at this site because a removal action completed in May 1991 eliminated the source of contamination. Potential health risks remaining at the site, quantified during the risk assessment and presented in Table 5-31, are all within acceptable limits.

5.6.6 Hazardous Materials Storage Area (SS-01)

5.6.6.1 Groundwater

Groundwater at this site was not monitored because there was no indication or evidence of a pathway to groundwater from suspect soils. Therefore, chemicals of potential concern for SS-01 groundwater do not require identification.

5.6.6.2 Soils

The determination of chemicals requiring remedial action to meet remediation goals for this site is presented in Table 5-43. The UCL concentrations of all chemicals/metals in the SS-01 soil samples were below the remediation goals as presented in Appendix B. Therefore, remedial action is not required at SS-01 to meet remediation goals, and no further action is required at this site.

5.6.7 USTs at Building 789 (ST-05)

5.6.7.1 Groundwater

Groundwater at this site was not monitored because there was no indication or evidence of a pathway to groundwater from suspect soils. Therefore, chemicals of potential concern for ST-05 groundwater do not require identification.

5.6.7.2 Soils

No further action is required at this site because a removal action was conducted in December 1990 and confirmatory soil sampling and analysis performed in September 1991 verified that all residual health risks associated with this site are within acceptable limits. The residual health risks were quantified during the risk assessment and are presented in Table 5-33.

Table 5-43

Determination of Remedial Action for Chemicals of Potential Concern
SS-01 Soils
Williams Air Force Base

Chemical of Potential Concern	Range or Value of Detection Limits (mg/kg)	Background Range or Value (mg/kg)	RG (mg/kg)	UCL[a] Concentration (mg/kg)	Basis for No Further Action
Acetone	0.01-0.012	NA	5,490	0.0065	UCL concentration is below RG
Di-n-butylphthalate	0.002-2.738	NA	2,330	0.134	UCL concentration is below RG
Diethyl phthalate	0.001-1.369	NA	22,000	0.089	UCL concentration is below RG
Ethyl benzene	0.01-1.0	NA	4,940	0.691	UCL concentration is below RG
Methylene chloride	0.01-1.0	NA	32.4	2.819	UCL concentration is below RG
Xylenes	0.01-2.0	NA	85,600	1.548	UCL concentration is below RG
Arsenic	2.0	2.3-4.3	78	2.0	UCL concentration is below RG
Beryllium	0.01-1.0	1.0-1.6	1.0-1.6	1.1	UCL concentration is within RG and background ranges
Cadmium	0.40-67	ND (<1)	14.0	2.1	UCL concentration is below RG
Chromium	0.7-2.0	16.9-24.8	390	23	UCL concentration is below RG
Copper	0.60-5.0	ND (<5)	2,900	42	UCL concentration is below RG
Lead	0.6-4.0	10.4-19.4	55	16	UCL concentration is below RG
Nickel	2.0-8.0	15.6-24.7	1,600	20	UCL concentration is below RG
Silver	0.70-2.0	ND (<2)	235	1.3	UCL concentration is below RG
Zinc	0.2-4.0	ND (<4)	15,600	61.0	UCL concentration is below RG

NA=not available or not used for comparison
[a]UCL=arithmetic mean of concentrations plus two standard deviations (95% confidence level).

5.6.8 USTs at Building 725 (ST-06)

5.6.8.1 Groundwater

Groundwater at this site was not monitored because there was no indication or evidence of a pathway to groundwater from suspect soils. Therefore, chemicals of potential concern for ST-06 groundwater do not require identification.

5.6.8.2 Soils

No further action is required at this site because a removal action was conducted in December 1990 and confirmatory soil sampling and analysis performed in September 1991 verified that all residual health risks associated with this site are within acceptable limits. The residual health risks were quantified during the risk assessment and are presented in Table 5-34.

5.6.9 USTs at Building 1086 (ST-07)

5.6.9.1 Groundwater

Groundwater at this site was not monitored because there was no indication or evidence of a pathway to groundwater from suspect soils. Therefore, chemicals of potential concern for ST-07 groundwater do not require identification.

5.6.9.2 Soils

No further action is required at this site because a RCRA partial closure action was performed in 1987 and confirmatory soil sampling and analysis performed in September 1991 verified that all residual health risks associated with the site are within acceptable limits. The residual health risks were quantified during the risk assessment and are presented in Table 5-35.

5.6.10 USTs at Building 1085 (ST-08)

A RCRA partial closure action was performed at this site resulting in recommendations that it be considered as part of the OU-1 FS report.

5.6.10.1 Groundwater

Groundwater at this site was not monitored because there was no indication or evidence of a pathway to groundwater from suspect soils. Therefore, chemicals of potential concern for ST-08 groundwater do not require identification.

5.6.10.2 Soils

The determination of chemicals requiring remedial action to meet remediation goals for this site is presented in Table 5-44. The UCL concentrations of all chemicals/metals in the ST-08 soil samples were below the remediation goals presented in Appendix B except antimony. The removal action performed in 1990 eliminated the only significant exposure pathway identified during the risk assessment (incidental ingestion of soil) to potential receptors. Therefore, remedial action is not required at ST-08 to meet remediation goals, and no further action is required.

Table 5-44

Determination of Remedial Action for Chemicals of Potential Concern
ST-08 Soils
Williams Air Force Base

Chemical of Potential Concern	Range or Value of Detection Limits (mg/kg)	Background Range or Value (mg/kg)	RG (mg/kg)	UCL[a] Concentration (mg/kg)	Basis for No Further Action
Acetone	0.01-6.3	NA	5,490	0.475	UCL concentration is below RG
Benzoic acid	1.6-1.9	NA	110,000	1.079	UCL concentration is below RG
Benzyl alcohol	0.33-0.39	NA	8,240	0.305	UCL concentration is below RG
Bis(2-ethylhexyl)phthalate	0.33-0.39	NA	22.9	1.026	UCL concentration is below RG
Chrysene	0.33-0.39	0.078-0.64	34	0.283	UCL concentration is below RG
Di-n-butyl phthalate	0.33-0.39	NA	2,330	0.186	UCL concentration is below RG
Diethyl phthalate	0.33-0.39	NA	22,000	0.088	UCL concentration is below RG
Methylene chloride	0.005-3.1	NA	75.8	0.026	UCL concentration is below RG
4-Methylphenol	0.33-9.9	NA	NA	3.368	No toxicity information is available for developing an action level for this compound
Phenanthrene	0.33-0.39	0.048-0.14	NA	0.43	No toxicity information is available for developing an action level for this compound
Tetrachloroethene	0.005-3.1	NA	12.6	0.303	UCL concentration is below RG
Xylenes	0.005-3.1	NA	110,000	4.3	UCL concentration is below RG
Antimony	12 - 15	ND (<12)	31.3	43	Antimony contamination was removed during initial removal action
Cadmium	1.0 - 2.0	ND (<1)	14.0	3.2	UCL concentration is below RG
Chromium	2.0-3.0	16.9-24.8	390	58	UCL concentration is below RG
Copper	5.0-8.0	ND (<5.0)	2,900	27	UCL concentration is below RG

Table 5-44

Chemical of Potential Concern	Range or Value of Detection Limits (mg/kg)	Background Range or Value (mg/kg)	RG (mg/kg)	UCL[a] Concentration (mg/kg)	Basis for No Further Action
Lead	1.0-2.0	10.4-19.4	55	45	UCL concentration is below RG
Nickel	8.0-10	15.6-24.7	1,600	42	UCL concentration is below RG
Zinc	4.0-5.0	ND (<4)	15,600	124	UCL concentration is below RG
Cyanide	0.47 - 1.0	NA	1,560	1.2	UCL concentration is below RG

NA=not available or not used for comparison
[a]UCL=arithmetic mean of concentrations plus two standard deviations (95% confidence level).

6.0 Description of Alternatives

Under CERCLA, a process has been established to develop, screen, and evaluate appropriate remedial alternatives. A wide range of cleanup options were considered for remedial action at LF-04. Remedial alternatives were not developed for sites other than LF-04 because the Landfill is the only site requiring remedial action.

The initial process options considered during the preliminary screening process are presented in Figure 6-1. The process options were evaluated, and retained or eliminated from further consideration on the basis of technical feasibility. Figure 6-1 presents the rationale for eliminating process options.

A second screening step was then performed to evaluate the remaining process options on the basis of implementability, effectiveness, and cost. The result of the screening process was intended to select one representative process option for each technology type for detailed analysis. The secondary screening was a two-step process. First, the process options retained from preliminary screening were ranked according to the previously mentioned three criteria to eliminate those options that were obviously inappropriate. The results of this step are presented in Figure 6-2. The process options that remained after step one, shown in Table 6-1, were then subjected to a more detailed evaluation based on the three criteria. After this evaluation was completed, the following two alternatives for LF-04 surface soils were retained for detailed analysis:

- Alternative A - No action
- Alternative B - Institutional action and capping.

These alternatives were developed based on site-specific needs and evaluated using the nine criteria developed by EPA to address CERCLA requirements. The evaluation criteria presented in Figure 6-3 are used to determine the most appropriate alternative. The following sections present detailed descriptions of the two remedial alternatives for surface soils at LF-04.

General Response Action	Technology Type	Process Option Assessment - Technical Implementability	Comments
No Action	N/A	N/A	
Institutional Action	Access Restrictions	Deed Restrictions	
		Fencing, Signs	
Containment	Capping	Permeable Layer Cap	
		Impermeable Layer Cap	
Containment/Treatment	Capping	Permeable Layer Cap	
		Impermeable Layer Cap	
	In Situ Treatment	Soil Flushing	Not an effective treatment for dieldrin. No practical receptor for flushing agent.
		Soil Vapor Extraction	Not applicable for surface soil application or for contaminants with low vapor pressures.
		Steam/Air Stripping	Not applicable for surface soil application or for contaminants with low vapor pressures.
		Oxidation	Not an effective treatment for dieldrin or beryllium.
		Vitrification	Not applicable for organic contaminants.
		Inorganic Stabilization	Not applicable for organic contaminants.
		Radio Frequency Heating	Not an effective treatment for beryllium.
		Bioremediation	Beryllium is not biodegradable.
Removal/Disposal	Excavation	Conventional Excavation	
	Off-Site Disposal	Non-RCRA Landfill	
		RCRA Facility	
	On-Site Disposal	Non-RCRA Landfill	No such facility exists.

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Figure 6-1. Initial Screening of Technologies and Process Options for Soil at LF-04

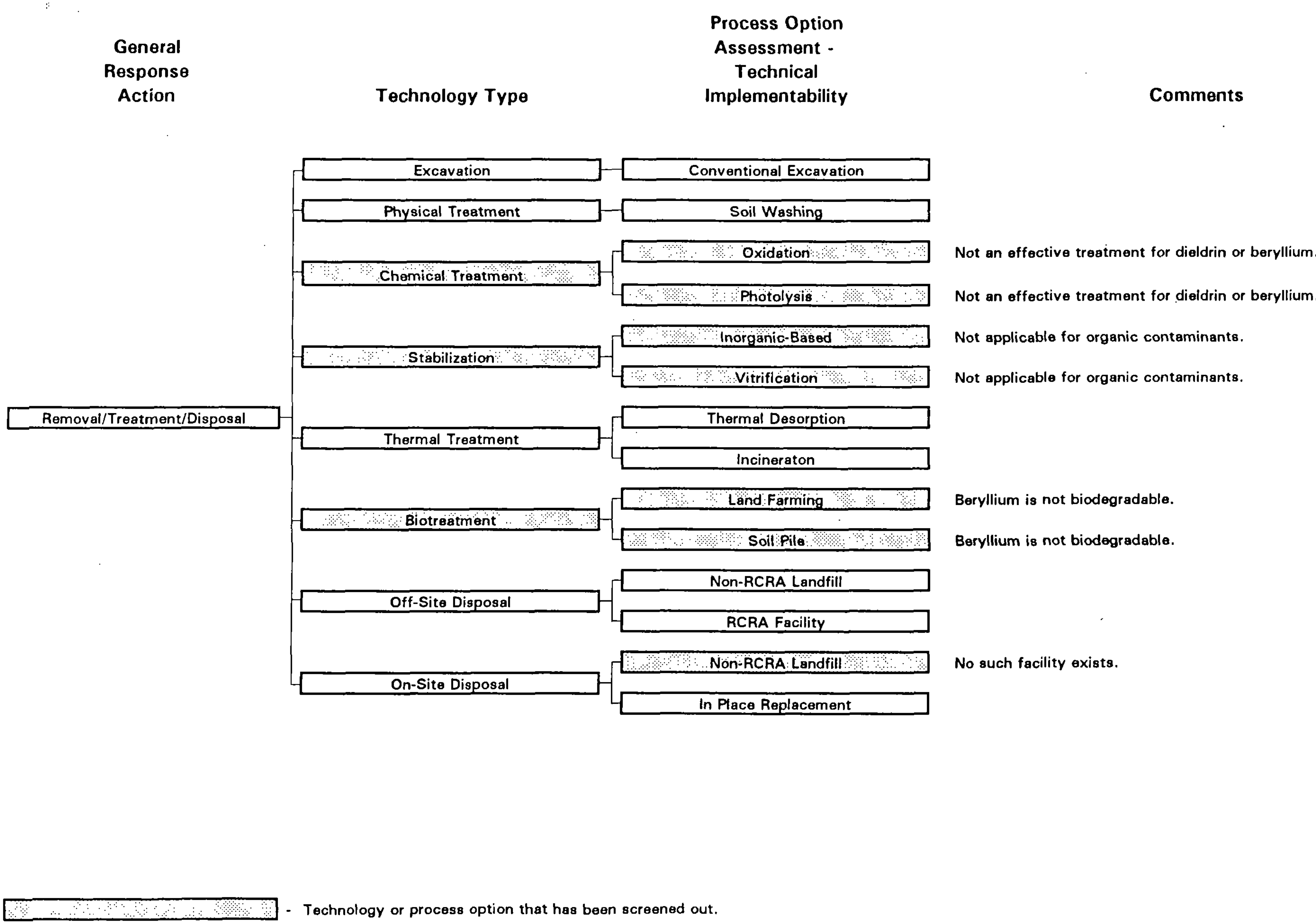

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Figure 6-1(Cont). Initial Screening of Technologies and Process Options for Soil at LF-04

General Response Action	Technology Type	Process Option	Institutional Implementability	Effectiveness in Meeting RAOs	Cost
No Action	N/A	**N/A**	Easily Implementable	Not Effective	Low
Institutional Action	Access Restrictions	**Deed Restrictions**	Easily Implementable	Somewhat Effective	Low
		Fencing, Signs	Easily Implementable	Somewhat Effective	Low
Containment	Capping	**Permeable Layer Cap**	Easily Implementable	Not Effective	Low to Moderate
		Impermeable Layer Cap	Implementable	Effective	Moderate
Removal/Disposal	Excavation	**Conventional Excavation**	Implementable with Difficulty	Very Effective	Low
	Off-Site Disposal	**Non-RCRA Landfill**	Implementable with Difficulty	Somewhat Effective	Low
		RCRA Facility	Implementable but Soil is Not a RCRA Waste	Somewhat Effective	Moderate
Removal/Treatment/Disposal	Excavation	**Conventional Excavation**	Implementable with Difficulty	Very Effective	High
	Physical Treatment	**Soil Washing**	Implementable with Difficulty	Effective	High
	Thermal Treatment	Thermal Desorption	Implementable with Difficulty	Somewhat Effective	High
		Incineraton	Implementable with Difficulty	Somewhat Effective	High
	Off-Site Disposal	**Non-RCRA Landfill**	Implementable	Somewhat Effective	Low
		RCRA Facility	Implementable	Somewhat Effective	Moderate
	On-Site Disposal	**In Place Replacement**	Implementable with Moderate Difficulty	Somewhat Effective	Low

Bold box - Process Option Retained

Figure 6-2. Secondary Screening of Technologies and Process Options for Soil at LF-04

Table 6-1

LF-04 Soil Alternatives for Inclusion in the Screening Process
Williams Air Force Base

Alternative	Description
S-1	No action
S-2	Institutional action
S-3	Excavation and off-site disposal
S-4	Capping
S-5	On-site incineration
S-6	Soil washing

THRESHOLD CRITERIA

OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT
Requires the assessment of alternatives to determine how they will provide human health and environmental protection from the risks present at a site by eliminating, reducing or controlling the hazardous material detected during the Remedial Investigation.

COMPLIANCE WITH ARARs
Requires the assessment of alternatives to determine how they meet the requirements under federal environmental laws and state environmental or facility siting laws.

PRIMARY BALANCING CRITERIA

LONG-TERM EFFECTIVENESS AND PERMANENCE
This criterion requires the evaluation of residual risks remaining at a site after completion of the remedial action.

REDUCTION OF TOXICITY, MOBILITY, AND VOLUME
This criterion addresses the statutory preference for selecting remedial actions that permanently and significantly reduce the toxicity, mobility, or volume of hazardous substances at a site by evaluating the extent to which this is achieved by each alternative.

SHORT-TERM EFFECTIVENESS
This criterion evaluates a remedial alternative's impact on human health and the environment during implementation.

IMPLEMENTABILITY
This criterion evaluates both the technical and administrative feasibility of implementing an alternative including the availability of key services and material required during its implementation.

COST
Under this criterion, capital costs, annual operation and maintenance costs and the net present value of capital O&M costs are assessed for each alternative.

MODIFYING CRITERIA

STATE ACCEPTANCE
This criterion addresses the statutory requirement for substantial and meaningful state involvement. Evaluation of this criterion is conducted by U.S. EPA and addressed during development of the Record of Decision.

COMMUNITY ACCEPTANCE
This criterion assesses the community's apparent preference for, or concerns about, the remedial alternatives. This process is conducted by U.S. EPA and addressed during development of the Record of Decision.

Figure 6-3. Remedial A native Evaluation Criteria

6.1 Alternative A - No Action

6.1.1 Major Components of the Remedial Alternative

The no-action alternative is included in accordance with the NCP to serve as a baseline for comparison with the other alternatives. This alternative would leave approximately 59,000 cubic yards of contaminated surface soils and an undetermined volume of buried landfill wastes in place with no additional means to prevent accidental exposure or erosion. Surface soils are contaminated with dieldrin at concentrations of 0.0045 to 0.25 mg/kg and beryllium at concentrations of 1.8 to 3.8 mg/kg. The alternative does include annual soil monitoring and semiannual (every 6 months) groundwater monitoring for specified chemicals of potential concern, and maintenance of all associated monitoring equipment.

6.1.2 Source Treatment Component

The alternative incorporates no treatment component that would result in a permanent reduction of the toxicity or volume of contaminants in the surface soils.

6.1.3 Source Containment Component

This alternative incorporates no containment component that would restrict the migration of contaminants from the surface soils.

6.1.4 Groundwater Component

The remedial alternative does not incorporate a groundwater extraction and treatment component.

The remedial alternative does provide for institution of a 30-year groundwater monitoring program with data collected and analyzed semiannually to ensure the protection of public health and the environment by confirming that groundwater quality is not being adversely affected by potential leachate migration from the landfill. A detection monitoring program will be established in accordance with the requirements of 40 Code of Federal Regulations (CFR) 264.98 to analyze for waste constituents and indicator parameters to permit detection and measurement of hazardous constituents in the uppermost aquifer at the point of compliance. The chemicals of potential concern at LF-04 will comprise the baseline list of hazardous constituents to be monitored. Constituents may be added to or removed from this list in the remedial design/remedial action (RD/RA) phase.

The groundwater monitoring program will utilize sampling and analytical methods that are appropriate for groundwater sampling and that accurately measure the hazardous constituents in groundwater samples. Because certain well construction materials (i.e., chromium and nickel) have been determined to produce analytical results not indicative of the contamination at the site, the sampling methodology will be assessed and modified to ensure representative results.

The groundwater detection monitoring program will comply with the requirements of 40 CFR 264.91-100, Subpart F. Semiannual groundwater monitoring data and analyses will be provided to the regulatory agencies. The details of the groundwater monitoring program, such as the point of compliance and the location of compliance and background monitoring wells will be determined during the RD/RA phase.

6.1.5 General Components

No institutional controls will be utilized in the implementation of this alternative. Surface soils at the landfill will be sampled annually and analyzed for chemicals of potential concern.

There are no implementation requirements of concern for this alternative.

The initial risk in implementing the remedial alternative is very low because no remedial action will be taken at the site that could create potential exposures.

The residual risk for this alternative is higher than for any other alternative because no action will be taken to reduce or eliminate potential current or future exposures to surface and subsurface soil contamination by containment or treatment. The lack of any erosion control measures could potentially result in migration of contaminants by windblown fugitive dust or storm water runoff, and future exposures to buried landfill wastes. Long-term groundwater monitoring is required to ensure that the buried landfill wastes left in place do not impact groundwater.

6.1.6 Cost

The estimated present worth cost for semiannual monitoring and maintenance for 30 years and 5-year reassessments is $505,000. Annual operation and maintenance (O&M) costs, primarily for monitoring and maintenance, are $54,000. There are no initial capital costs.

6.2 *Alternative B - Institutional Action and Capping*

6.2.1 *Major Components of the Remedial Alternative*

The major features of this alternative include: constructing a permeable cap over the contaminated surface soils; installing an interceptor trench around the perimeter of the capped area; erecting a fence around the perimeter of the interceptor trench; implementing land-use restrictions; and performing 30-year postclosure care, including landfill cover maintenance, annual soil monitoring and semiannual groundwater monitoring for specified chemicals of potential concern, and maintenance of all necessary monitoring equipment. The installation of a cap will leave approximately 59,000 cubic yards of contaminated surface soils and an undetermined volume of buried landfill wastes in place and, therefore, involves no excavation of contaminated surface soils. Surface soils are contaminated with dieldrin at concentrations of 0.0045 to 0.25 mg/kg and beryllium at concentrations of 1.8 to 3.8 mg/kg.

6.2.2 *Source Treatment Component*

The alternative incorporates no treatment component that would result in the permanent reduction of the toxicity or volume of contaminants in surface soils.

6.2.3 *Source Containment Component*

The containment component of the remedial alternative consists of the landfill cap. The purpose of the cap is to provide protection against human health risks associated with the site. The chemicals of potential concern present in surface soils at concentrations above final remediation goals are dieldrin and beryllium. The cap addresses this health risk by eliminating the exposure pathways to potential receptors identified during the baseline risk assessment: dermal contact with soil, incidental ingestion of soil, and inhalation of fugitive dust.

The remedial alternative will comply with ARARs concerning cap design and construction as stated in the following requirements presented in 40 CFR 264.310:

- Provide long-term minimization of migration of liquids through the capped area.
- Function with minimum maintenance.
- Promote surface drainage and minimize erosion or abrasion of the cover.
- Accommodate settling and subsidence so that the cover's integrity is maintained.

- Restrict postclosure use of property as necessary to prevent damage to the cover.

- Prevent run-on and runoff from damaging cover.

- Provide postclosure care for 30 years, including landfill cover maintenance, annual soil monitoring, semiannual groundwater monitoring, and maintenance of associated monitoring equipment.

A preliminary cap design proposed during the FS is presented in Figure 6-4. The cap design consists of a layer of leveling fill, an additional 24-inch soil cover and finally a 12-inch rubblized concrete layer. The initial application of fill would be installed to level the surface of the landfill area, which is uneven due to subsidence of the buried wastes. The 24 inches of soil placed after the leveling fill would be graded to prevent erosion from stormwater run-on and promote drainage of incident stormwater. The placement of the rubblized concrete would discourage human intrusion and provide long-term protection of the soil cover by minimizing erosion or abrasion of the soil cover, accommodating settling and subsidence without compromising the protective nature of the cap, and preventing stormwater runoff from damaging the soil cover. The proposed cap design would require minimum maintenance. Although the proposed design will not minimize the migration of liquids through the capped area due to its permeable nature, this requirement is not a significant consideration for this site because the climate of the area is such that effective precipitation (precipitation that can reach the water table) is negligible.

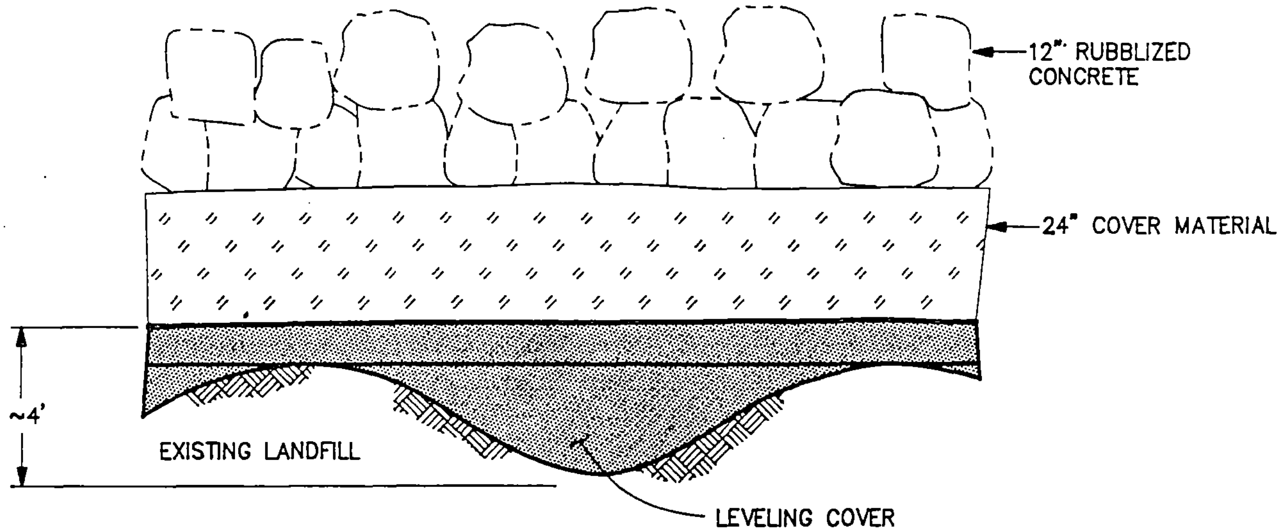
An interceptor trench would be constructed around the perimeter of the landfill cap to aid in the collection and proper routing of any stormwater runoff from the capped area.

The landfill cap would be maintained for 30 years as required in 40 CFR 264.310.

The preliminary cap design may be modified during the remedial design process, but any changes must result in a design that complies with the intent of the ARARs previously discussed.

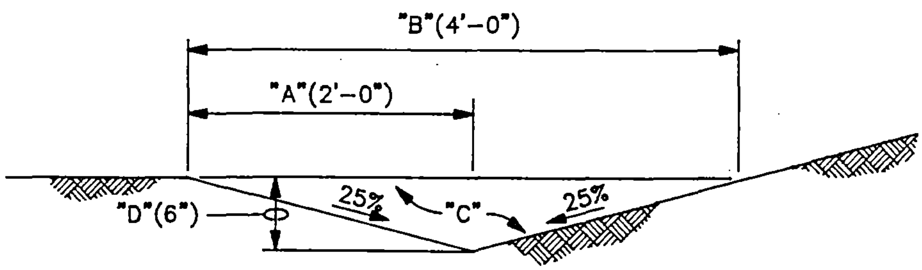
6.2.4 Groundwater Component

The remedial alternative does not incorporate a groundwater extraction and treatment component. The RI/FS process determined that there were currently no chemicals of potential concern in groundwater with concentrations in excess of final remediation goals. Current



SOIL & RUBBLIZED CONCRETE CAP

NOT TO SCALE



DRAINAGE DITCH

NOT TO SCALE

FIGURE 6-4

WILLIAMS AIR FORCE BASE
CONCEPTUAL DIAGRAM FOR
SOIL AND RUBBLIZED CONCRETE
CAP AND DRAINAGE DITCH

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 8/31/93	DATE LAST REV.: 12/9/93	DRAFT. CHCK. BY: R. PITTS	INITIATOR: W. ANDERSON	DWG. NO.: 409735-A-130
DRAWN BY: S. CARDWELL	DRAWN BY: J. TABLER	ENGR. CHCK BY: W. ANDERSON	PROJ. MGR.: W. CARTER	PROJ. NO.: 409735

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potential health risks associated with all exposure pathways were found to be within acceptable levels (ILCR less than 1 x 10^{-6} and HI less than 1).

The remedial alternative does provide for institution of a 30-year groundwater monitoring program, with data collected and analyzed semiannually, to ensure the protection of public health and the environment by confirming that groundwater quality is not being adversely affected by potential leachate migration from the landfill. A detection monitoring program will be established in accordance with the requirements of 40 CFR 264.98 to analyze for waste constituents and indicator parameters to permit detection and measurement of hazardous constituents in the uppermost aquifer at the point of compliance. The chemicals of potential concern at LF-04 will comprise the baseline list of hazardous constituents to be monitored. Constituents may be added to or removed from this list in the RD/RA phase.

The groundwater monitoring program will utilize sampling and analytical methods that are appropriate for groundwater sampling and that accurately measure the hazardous constituents in groundwater samples. Because certain well construction materials (i.e., chromium and nickel) have been determined to produce analytical results not indicative of the contamination at the site, the sampling methodology will be assessed and modified to ensure representative results.

The groundwater detection monitoring program will comply with the requirements of 40 CFR 264.91-100, Subpart F. Semiannual groundwater monitoring data and analyses will be provided to the regulatory agencies. The details of the groundwater monitoring program, such as the point of compliance and the location of compliance and background monitoring wells, will be determined during the RD/RA phase.

6.2.5 General Components

The following institutional controls will be utilized as a part of the remedial alternative:

- A fence will be erected around the perimeter of the landfill interceptor trench and signs posted to notify potential land users of the presence of the cap covering the contaminated surface soils and buried landfill waste.

- Land-use restrictions will be implemented to protect the integrity of the landfill cover and the operation of the groundwater monitoring system.

The major implementation concern for this alternative is the ability of the landfill area to withstand the traffic from the heavy equipment used during cap construction. The landfill soils have settled unevenly due to variable nature of the buried waste, and potential settling should be monitored closely during remediation. Relocation of existing groundwater monitoring wells should not be required, but they may need to be protected during backfill placement and cap construction.

The initial risk in implementing the remedial alternative is low because soil or waste materials will not be excavated, and no treatment is involved to generate air emissions or other treatment residuals. The grading work will disturb surface soils with the potential to entrain and disperse contaminated soil particles into the air where workers could be exposed via inhalation. This risk can be reduced by:

- Implementing appropriate dust control measures to minimize dust emissions
- Training remediation workers
- Using personal protection equipment for workers.

Although the alternative does not result in permanent reductions in the volume or toxicity of contamination, the cap would eliminate the exposure pathways of concern and therefore all current and future risks associated with the contaminated surface soils. The cap will reduce the mobility of contaminants in surface soils and some natural attenuation of the concentration of organic contaminants could occur over time.

The implementation of the cap would result in 59,000 cubic yards of contaminated surface soil and an undetermined volume of buried landfill wastes remaining in place. The fate and transport analysis presented in Section 4.2.2.1 concludes that given the depth to groundwater, the climate in the area, and the concentration and immobile nature of the contaminants, it would be virtually impossible for the contamination in the surface soils to affect groundwater quality. Groundwater quality could be affected by potential leachate from the buried landfill wastes, which is the principal residual risk associated with Alternative B. This residual risk would be addressed by the institution of a long-term groundwater monitoring program. The groundwater monitoring program would provide the necessary protection for human health and the environment by detecting contamination and permitting remedial action before potential receptors would be exposed.

The alternative and all its components will be reviewed every 5 years as required under CERCLA to ensure protection of public health and the environment.

6.2.6 Cost

The estimated present net worth cost of this alternative is $3.25 million. The initial construction cost represents $2.77 million of this total, with the remaining cost contributed by 5-year reviews of contaminant levels and periodic cap maintenance. The alternative includes semiannual groundwater monitoring and maintenance of all associated equipment. The annual O&M costs are estimated to be approximately $50,000. The cap construction is estimated to require 6 months to complete.

7.0 Comparative Analysis of Alternatives

The final phase in the evaluation of remedial alternatives involves a comparison of the various alternatives. The advantages and disadvantages of each alternative are reviewed relative to each of the nine EPA evaluation criteria presented in Figure 6-3. The following sections present the evaluation process for the Landfill (LF-04). None of the remaining nine sites in OU-1 require remedial action, and therefore, are not discussed in this section. For each evaluation criterion discussed, the apparent best alternative is identified first. Table 7-1 summarizes the results of the remedial alternative evaluation process for LF-04.

7.1 Overall Protection of Human Health and the Environment

Alternative B will be protective of human health and the environment. The alternative will provide a barrier against exposure to contaminated surface soils and would limit the potential for excavation or other soil disturbance activities that could result in receptors contacting surface soils and buried landfill wastes. In addition, the rubblized concrete layer would be difficult for humans to navigate and would also discourage intrusion.

Alternative A will not control exposure to the contaminated surface soil or reduce the potential human health risk associated with exposure. In fact, the potential for exposure to the buried landfill wastes or fugitive dust could increase due to natural erosion processes. Migration of the contaminants from surface soil to surface water via infiltration could adversely affect surrounding surface soils or water quality.

7.2 Compliance with Potential ARARs

Alternative B will meet all location- and action-specific ARARs listed in Appendix C.

EPA does not consider Alternative A to be a "remedial action" because no action is being taken. Therefore, the requirements of CERCLA Section 121 concerning ARARs do not apply, and ARARs are not identified. This alternative will only be evaluated to determine if it is protective of human health and the environment.

7.3 Long-Term Effectiveness and Permanence

Alternative B will provide long-term protection if the cap is maintained periodically and if means are taken to avoid damage or removal of the cap. This alternative would restrict future property use and development, but even if the contaminated surface soils were removed, this

Table 7-1

Comparison of Cleanup Alternatives
Williams Air Force Base

Alternative	A. No Action	B. Institutional Actions and Capping
Overall Protection of Human Health and the Environment	Not protective	Protective - provides barrier
Compliance with ARARs	Not applicable	Complies
Long-Term Effectiveness and Permanence	Not a permanent solution	Achieves a permanent and effective solution
Reduces Toxicity, Mobility, or Volume	No reduction	Reduces mobility - Toxicity and volume are not affected
Short-Term Effectiveness	Not effective	Effective
Implementability	Most implementable	Easily Implementable
Cost (Present Worth)	$0.51 M	$3.32 M
State Acceptance	Acceptable	Acceptable
Community Acceptance	Acceptable	Acceptable
Estimated Remedial Duration (Years)	> 100	> 30

M - Million.

area would remain restricted due to buried landfill wastes. Because the contamination would not be removed or treated, there would be continuing potential liability because surface soil exposure could occur.

Alternative A does not provide controls for reducing potential exposure to contaminants or long-term management measures. Remedial action objectives (RAO) may eventually be met for dieldrin due to natural contaminant attenuation processes; however, no such natural attenuation would occur for beryllium. The potential for exposure to contamination could increase over time because surface contaminants could be transported by the wind as fugitive dust, and soil erosion could result in exposing buried landfill wastes.

7.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative B will not reduce toxicity or volume of the chemicals of potential concern because treatment is not accomplished. However, the cap would retard the mobility of the contamination in the surface soils. Minor reductions in the mass of some organic surface contamination may occur over time through natural attenuation processes.

Alternative A will not reduce the toxicity, mobility, or volume of contaminated surface soil. Minor reductions in the mass of some organic surface contamination may occur over time through natural attenuation processes.

7.5 Short-Term Effectiveness

There will be no additional short-term risk posed to the general public, workers, or the environment as a result of pursuing Alternative A.

Alternative B could be designed and installed within 6 months of initiating construction. Risks to workers would be comparable to those normally encountered during construction activities; however, there could be additional increased risk to workers from inhalation of fugitive dust, incidental ingestion, or dermal contact with the contaminated soils. Dust control should be employed to further reduce worker exposure to fugitive dusts. Implementation risks to the general public or the environment during construction would be negligible because excavation of contaminated surface soil would not be required. Traffic activity on top of LF-04 should be controlled to prevent the equipment required for backfill and cap construction activities from exposing buried landfill wastes due to further differential settling.

7.6 Implementability

There will be no implementability concerns for Alternative A.

No special techniques, materials, or services would be required to implement Alternative B. The cap could be extended in the future if it were determined that contaminant concentrations exceeded remedial goals beyond the initial area of the cap. Provisions for the addition of fill soil are necessary due to the variable terrain at LF-04 to bring the landfill up to grade for proper runoff prior to installation of the cap. The rubblized concrete would be furnished from the Hardfill Area on the Base, an area used for storage of dismantled runway building materials. A portion of this material would be used on top of the soil cover to provide erosion control and to prevent intrusion.

7.7 Cost

The cost of the Alternative A consists of semiannual monitoring of surface soil and ground-water contaminant levels, plus a reassessment of conditions every 5 years. The estimated present worth cost is $505,000. There are no initial capital costs, but the annual O&M costs are approximately $54,000.

The projected present worth cost of Alternative B is $3.25 million. The initial construction cost represents approximately $2.77 million of this total, with the remaining cost contributed by 5-year reviews of contaminant levels and periodic cap maintenance. This alternative also includes semiannual groundwater monitoring. The annual O&M costs are $50,600.

A cost estimate summary is presented in Table 7-2. Detailed estimates are presented in Appendix D of this document.

7.8 State Acceptance

Upon signing of this OU-1 ROD, the State of Arizona concurs with the selected remedies for OU-1 sites.

7.9 Community Acceptance

Based on the level and type of comments received from the public concerning the preferred remedy for OU-1 sites, the public concurs with the selected remedies for OU-1 sites. Chapter 11.0 contains further information concerning comments received from the community.

Table 7-2

Summary of Remedial Alternative Cost Estimates
Williams Air Force Base

Cost Component	A No Action	B Capping
Soil Action		
1. Capital costs	$0	$2,839,400
2. Annual operating and maintenance costs (O&M)	$53,600	$50,600
3. Present worth of O&M	$505,300	$477,000
Total Present Worth	$505,300	$3,316,400

Note: A 10% discount rate and 30 years was used to calculate all O&M present worth values.

8.0 Selected Remedy

The selected remedy for LF-04 is Alternative B - Institutional Actions and Capping. The specific components of this alternative are presented in Section 6.2 and are further described in this section.

Alternative B satisfies the two threshold criteria, overall protection of human health and the environment and compliance with ARARs, and provides the best balance of the nine evaluation criteria presented in Figure 6-3. The selected remedy will provide the greatest level of effectiveness that is technically and economically feasible. The criterion of protection of human health and the environment is appropriately balanced with both effectiveness and technical/economic feasibility.

Residual risk from this selected alternative, although qualitatively addressed in this ROD in Sections 6.0 and 7.0, will be addressed quantitatively in the comprehensive baseline risk assessment for the entire Base.

8.1 Major Components of the Selected Remedy

The major components of the selected remedy to be implemented at LF-04 include the following:

- Installing a permeable cap over the contaminated surface soils
- Installing an interceptor trench around the perimeter of the capped area
- Erecting a fence around the perimeter of the interceptor trench
- Imposing land-use restrictions to protect the integrity of the landfill cover and the operation of the groundwater monitoring system
- Performing postclosure care for 30 years, including landfill cover maintenance, annual soil monitoring, semiannual (every 6 months) groundwater monitoring, and periodic maintenance of monitoring equipment.

Additional details about the selected remedy are presented in Sections 6.2 to 6.2.6.

Remedial action is required at the site due to the presence of dieldrin and beryllium in LF-04 surface soils at concentrations in excess of remediation goals. The cap will be constructed over the contaminated surface soils at LF-04 to eliminate the potential pathways for exposure to contaminants and thereby reduce the health risks associated with the site to acceptable levels (HI less than 1 and ILCR less than 10^{-6}). Existing conditions at the site have been determined to pose an excess lifetime cancer risk of 2.03×10^{-5} from current and future exposures to contaminated surface soils. The two significant exposure pathways are dermal contact with contaminated soil and incidental ingestion of contaminated soil. Although the remedy does not permanently reduce the volume or toxicity of the contamination, it accomplishes the primary remediation goal of overall protection of human health and the environment by providing a barrier between the contaminated media and any potential human or environmental receptors. The remedy also limits the potential for migration of the contamination through soil erosion. Although the remedy does not mitigate the potential migration of dieldrin from surface soils to groundwater, contaminant fate and transport calculations indicate that the surface contamination will not result in contaminant concentrations in groundwater that would raise the health risks to unacceptable levels.

A preliminary cap design has been proposed and is presented in Figure 6-4. The cap design involves the following features:

- A bottom layer of fill to level the landfill surface
- A 24-inch layer of soil graded to control stormwater runoff
- A layer of rubblized concrete to discourage human intrusion and provide long-term protection for the soil cover.

An interceptor trench will be constructed around the perimeter of the cap to aid in the collection and proper routing of stormwater runoff.

The institutional controls utilized by the remedy involve erecting a fence around the perimeter of the landfill and interceptor trench, and posting signs to notify potential land users of the presence of the cap covering the contaminated surface soils. In addition, land-use restrictions will be implemented to protect the integrity of the landfill cover and the operation of the groundwater monitoring system.

Installation of the cap over the landfill with the contaminated surface soils in place requires that the remedy provide for long-term postclosure care, including cap maintenance and groundwater monitoring. All postclosure activities will be conducted for a period of 30 years after the implementation of the remedy.

The remedy provides for institution of a 30-year groundwater monitoring program, with data collected and analyzed semiannually, to ensure protection of public health and the environment by confirming that groundwater quality is not being adversely affected by potential migration of landfill leachate. A detection monitoring program will be established in accordance with the requirements of 40 CFR 264.98 to analyze for waste constituents and indicator parameters to permit detection and measurement of hazardous constituents in the uppermost aquifer at the point of compliance. The specified chemicals of potential concern at LF-04 will comprise the baseline list of constituents to be monitored.

The groundwater monitoring program will utilize sampling and analytical methods that are appropriate for groundwater sampling and that accurately measure the hazardous constituents in groundwater samples. Because certain well construction materials (i.e., chromium and nickel) have been determined to produce analytical results not indicative of the contamination at the site, the sampling methodology will be assessed and modified to ensure representative results.

The groundwater detection monitoring program will comply with the requirements of 40 CFR 264.91-100 Subpart F. Groundwater monitoring data and analyses will be provided to the regulatory agencies on a semiannual basis. The details of the groundwater monitoring program, such as the point of compliance and the location of compliance and background monitoring wells, will be determined during the RD/RA phase.

Postclosure care would also include annual sampling and analysis of stormwater runoff for pesticides and priority pollutant metals, and routine maintenance of the landfill cap to ensure its integrity.

The landfill remedy will be subject to review every 5 years as required under CERCLA to ensure protection of public health and the environment.

8.2 Implementation Concerns

Prior to implementation of the remedy, consideration should be given to dust control measures that would minimize the potential entrainment and dispersion of contaminated soil particles into the air. This procedure is important to reduce the potential for exposure to contaminated soils for remediation workers. Dust control measures described in EPA guidance document "Dust Control at Hazardous Waste Sites" (EPA/540/2-85/003, 1985) should be reviewed and used where appropriate.

Due to uneven settling of waste fill areas, another consideration is the capacity of these areas to withstand traffic from the heavy equipment used during the construction of the cap. The potential settling of these fill areas should be carefully considered when designing the cap and also should be monitored closely during site work.

8.3 Cost

Preliminary cost estimates for the selected remedy are presented in Appendix D. Capital costs for capping are broken into direct and indirect costs. Direct costs include allowances for site preparation, cap construction, drainage ditch construction and fencing. Direct capital costs are estimated to be $2.15 million. Indirect capital costs such as engineering, permits, startup, and contingency are estimated to total $0.69 million. The total installed cost for the remedy is approximately $2.84 million.

Annual O&M expenses for the remedy are estimated to be approximately $51,000. This includes allowances for items such as semiannual groundwater sampling, cap maintenance, 5-year periodic site review, and a contingency factor.

The total net present worth cost for the selected remedy is approximately $3.32 million based on an interest rate of 10 percent and 30 years of operation, maintenance, and monitoring.

Some changes may be made to the selected remedy during the remedial design and construction process. Such changes, in general, reflect modifications from the engineering design process.

9.0 Statutory Determinations

Under Section 121 of CERCLA, the selected remedy must be protective of human health and the environment and must comply with all ARARs.

The selected remedy also must be cost-effective and utilize permanent solutions and alternative treatment technologies to the maximum extent practicable. Remedies that employ treatment that permanently and significantly reduce the volume, toxicity, or mobility of hazardous wastes as a major part of the remedy are preferable. How the selected remedy meets these requirements is discussed in this chapter.

The State of Arizona and the communities surrounding Williams AFB were involved in the determination of the selected remedy. The state was represented in the process by ADEQ and ADWR, both of whom are parties to the FFA. They have been intrinsically involved in the review and approval of all documents and decisions concerning the various stages of the remedial process, including all work plans, RI/FS reports, proposed plans, and RODs.

The communities surrounding Williams AFB have been involved in the decision-making process through the TRC, the Restoration Advisory Board (RAB), and through public meetings and comment periods on proposed remedies and removal actions. Chapter 11.0 of this document addresses the communities' involvement in more depth.

The selected remedy represents the best balance among alternatives with respect to pertinent criteria, given the scope of this action.

9.1 Protection of Human Health and the Environment

The selected remedy protects human health and the environment by providing a barrier against exposure to surface soils and by limiting the potential for excavation, erosion, or other soil disturbance activities that could result in receptors contacting surface soils and buried landfill wastes. In addition, the rubblized concrete layer will discourage intrusion, yet provide habitats for animal life in the area. No adverse effects as a result of potential cross-media transfers are expected. Control of fugitive dust emissions during construction of the cap will adequately control any potential exposure risk from that activity.

A cap will not directly reduce concentrations of contaminants in surface soils, but natural attenuation is a possibility. The selected remedy will prevent exposure by eliminating the exposure pathway to surface soils. Because the remediation goals are intended to be protective of human health and the environment, the magnitude of residual risk from exposure to surface soils will be reduced from those levels presented in the baseline risk assessment for present and future land use (Table 5-32) to acceptable levels.

9.2 Attainment of ARARs

The selected remedy will achieve all ARARs for the groundwater, soils, and air emissions. These ARARs are presented in detail in Appendix C.

9.3 Cost Effectiveness

The selected remedy (Alternative B) was evaluated for cost effectiveness against Alternative A. Although the selected remedy (capping) is more expensive than the no-action alternative, the no-action alternative is not protective of human health and the environment because of unacceptable risk. The remedy will provide effectiveness proportional to the cost of the remedy given the O&M and present worth cost for the protection of human health and the environment.

9.4 Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Possible

The selected remedy is the design concept that best represents the balance among alternatives with respect to the pertinent criteria, especially the balancing criteria of implementability, short-term effectiveness, and cost. Contaminants will be permanently removed from an exposure pathway by capping the landfill. The selected remedy did not utilize treatment because treatment of surface soils at the landfill is not practical due to potential exposure of buried landfill wastes. Excavation in relation to a remedy was eliminated from consideration during the evaluation of alternatives.

Resources will be conserved to the maximum extent possible using the selected remedy.

9.5 Preference for Treatment as a Principal Element

The requirement that treatment be a principal element of the remedy is not satisfied because the size of the landfill, the fact that there are no on-site hot spots that represent the major sources of contamination, and the fact that the contaminated surface soils cover buried landfill wastes preclude a remedy in which contaminants could be excavated and treated effectively. However, the selected remedy does utilize a technology that isolates the community and the environment from exposure to contaminants. This operable unit action is consistent with planned future Basewide actions and development to the extent possible.

10.0 Documentation of Significant Changes

The Proposed Plan for OU-1 was released for public comment on January 28, 1994. The OU-1 Proposed Plan identified the capping alternative for the Landfill; the no-action alternative for sites FT-03, SD-10, SS-01; and the no further action alternative for sites RW-11, DP-13, ST-05, ST-06, ST-07, and ST-08. The Air Force, EPA, and the State reviewed all written and verbal comments submitted during the public comment period. Upon review of these comments, the Air Force, EPA, and the State determined that no significant changes to the remedy, as it was originally identified in the Proposed Plan, were necessary.

11.0 Responsiveness Summary

11.1 Overview

The USAF published the Final Proposed Plan for cleanup of the OU-1 sites at Williams AFB in January 1994. There were two public comment periods on the Proposed Plan, one beginning October 6, 1993 and extending through November 5, 1993, and one beginning January 28, 1994 and extending through February 28, 1994. Two public meetings were held at the Mesa Rendezvous Center to present the plan to the public, one on October 14, 1993 and one on February 10, 1994. The reason for the second public meeting and comment period was that, at the time of the first meeting, additional investigations of the groundwater at the Landfill (LF-04) were still required for the Air Force to verify that the recommendation for no further action for groundwater remediation at LF-04 was appropriate. Those investigations confirmed that no further action for the groundwater at LF-04 is warranted. Groundwater monitoring will continue to be performed in conjunction with any remedial action to ensure that the groundwater beneath LF-04 is not impacted. The preferred remedial alternative specified herein involves capping the soils of LF-04. No other OU-1 site requires further action.

Both meetings with the public were sparsely attended, with fewer than 20 members of the community present. The panel was able to satisfy the members of the community with the responses given to questions asked at the meetings. The general tone of both meetings seemed to indicate that the members of the community attending the meeting were in favor of the proposed remedy.

These sections follow:

- Background on community involvement
- Summary of comments received during the public comment period and USAF responses
- Community relations activities at Williams AFB.

11.2 Background on Community Involvement

To date, the level of community interest and concern can be characterized as low regarding OU-1 in particular, and environmental cleanup in general, at Williams AFB. In contrast, the September 1993 closure of the Base generated great interest and sparked debate in the surrounding communities regarding Base reuse. This debate created an indirect interest on what effect, if any, the environmental contamination at the Base will have on future use or transfer of Base property. The local press has intermittently published articles regarding Base environmental activities and their potential impact on the area without arousing any significant controversy. *Wings*, the Base newspaper, has given coverage to the Base cleanup. Especially noteworthy were the articles in the 1992 Earth Day edition.

11.3 Summary of Comments Received During the Public Comment Period and USAF Responses

The first public comment period on the proposed plan for cleanup of OU-1 was held from October 6 to November 5, 1993. Comments received during this comment period are summarized below.

<u>Questions received at the First Public Meeting</u>

Question 1: Was the cost of the future use of the land that encompasses the landfill used in your estimate of the proposed remedial action?

Answer: *No. That was not factored into the cost estimate.*

Question 2: Will the land be permanently unavailable for future use?

Answer: *It will be unavailable for use and will be kept in the Air Force inventory probably for the next 50 years.*

Question 3: How does the proposed cap affect the reuse of the area?

Answer: *It will not affect the reuse of the area at all. The landfill will not be designated for reuse and it will be fenced off with a permeable cap placed on top of it and an interceptor ditch placed around it.*

<u>Comments received by letter</u>

The following comments were received in a letter from the Williams Redevelopment Partnership on October 26, 1993.

Comment 1: The Proposed Plan indicates the Air Force has selected the no action alternative for nine of the ten sites within OU-1. The Proposed Plan eliminates these sites from further consideration due to the completion of past removal actions and the determination that these sites do not pose unacceptable risks to human health or the environment. However, some of the sites contain subsurface soil contamination at various levels.

For instance, sites ST-05, ST-07, and ST-08 (UST sites) contain levels of petroleum constituents at levels exceeding soil cleanup guidance levels recommended by the ADEQ UST program. Under the UST program, ADEQ would normally require that the site be cleaned up to suggested levels before they would close the site. Under CERCLA, the Air Force has looked at exposure to the surface soils for purposes of risk assessment and determined no unacceptable risk to human health or the environment exists. However, the risk assessment does not take into account the reuse actions that may include exposure to workers during excavation of these areas for construction of new facilities. The risk assessment also does not consider the analytical results for TPH or HBFH because they are not particular constituents like benzene or toluene.

The IGA Group has several questions regarding these situations. Has the Air Force considered the effects on workers due to exposure to the subsurface soils during construction that may occur as part of reuse? Will the Air Force clean up the contamination if the reuse groups determine the affected areas are needed for construction of new facilities? Finally, why is the Air Force allowed to leave contamination at UST sites in the subsurface soils at levels that exceed recommended UST cleanup levels? If the Air Force does not remediate the contamination, the property cannot be considered clean under CERFA for transfer by deed. The IGA Group requests the Air Force and the regulatory agencies consider implementing a cleanup action for the UST sites in accordance with the ADEQ guidelines. Other UST sites on Williams AFB and at other private and public facilities are required to meet those levels since they are being closed under the ADEQ UST compliance program. The UST cleanup guidelines, while not considered ARARS under the National Contingency Plan (NCP), are designated as "To Be Considered" criteria. Under OU-2, the Air Force accepted Arizona Health Based Guidance Levels (HBGL) as cleanup standards even though they only meet the "To Be Considered" criteria. The IGA Group believes the UST cleanup guidelines should be treated the same as the HBGLs in OU-2 were to be consistent.

Response: *Based on this comment, the Air Force considered the effect of subsurface contaminants on a construction worker, in addition to the original occupational and residential scenarios presented in the OU-1 RI, for the UST sites. The results for the construction worker are presented in the Final Feasibility Study for OU-1 and Final Remedial Investigation Report Addendum for OU-1. The risk assessment determined that there were no unacceptable risks for any scenario from contaminants at these sites. Based on that evaluation, no additional action is required at the UST sites (ST-05, ST-06, ST-07, and ST-08) for reuse to proceed. After the OU-1 ROD is finalized, all OU-1 sites, except for the landfill, will be categorized as areas where all remedial actions have been completed to protect public health and the environment (Category 4). Under Section 120(h)(3) of CERCLA, Category 4 areas can be transferred.*

A risk assessment conducted according to EPA guidelines does not provide for quantitative evaluation of risks from TPH and HBFH, or other analytical test methods that measure a group of compounds. The risk assessment process, however, does allow for quantification of risks due to individual constituents of those analyses, such as benzene and toluene. Risks were therefore calculated for OU-1 sites for the individual constituents where these were analyzed. The risk assessment performed for OU-1 did not find unacceptable risks to human health and the environment from these compounds.

The ADEQ UST cleanup guidance levels referred to by the IGA Group were addressed during the establishment of the remedial goals for OU-1 through the evaluation of applicable or relevant and appropriate (ARAR) criteria or other criteria to be considered (TBC). It was agreed by the parties to the FFA that the ADEQ UST criteria are not applicable as ARARs or TBCs because they are only applicable to the Arizona UST program which is outside the jurisdiction of CERCLA. The levels selected during the remedial goal process are protective of human health and the environment. Only criteria listed as ARARs or TBCs have been evaluated in the remedial goal selection process. Both federal and state regulatory agencies have approved the remedial goal levels selected by the Air Force for OU-1 sites.

Comment 2: The Proposed Plan selects a no further action alternative for the Pesticide Burial Area (DP-13) based upon the removal action taken by the Air Force in 1991. In the Remedial Investigation Report for Operable Unit 1, the description of the investigation methods indicates three buried drums were detected west of the perimeter of the designated burial area and were removed. However, it does not indicate whether the Air Force continued investigation to determine if any additional drums were buried west of the designated area even though the magnetometer survey indicated the original boundary was incorrect. If this additional survey work was completed, it needs to be documented. If not, can the Air Force guarantee that all the buried drums have been identified and removed from this area? If the Air Force cannot guarantee all buried drums have been removed, the IGA Group requests the Air Force continue investigation of the site until such a guarantee can be made.

Response: *As the investigation of DP-13 was being completed in accordance with the approved Implementation Plan, drums were detected north and west of DP-13. A revised Figure 2-10 has been included in the final OU-1 ROD to accurately depict the extent of the magnetometer survey, which did extend beyond all magnetic anomalies detected. No further survey is therefore required or anticipated. An EE/CA was also written, coordinated, and approved by all Parties. It specified the actions to remove all drums from this site. There was also a public notification placed in the local newspaper regarding that EE/CA and intended removal action. No comments were made or concerns raised regarding an extension of the investigation or the extent of the removal action. The removal action was taken in accordance with the EE/CA and all drums were removed. Since the Air Force has complied with all plans and removed all buried drums, this action is considered complete. The purpose of the IRP is to identify and investigate all possible contaminated areas which the Air Force has done in accordance with approved plans. Further actions are therefore judged unnecessary.*

Comment 3: The selected action for the Landfill (LF-04) is described as a rubblized concrete and soil cover to protect LF-04 from erosion. This type of cover will not allow for reuse of the land for any purpose. However, other landfills in the United States have received vegetative covers that allow for the reuse of the land for recreational purposes, such as parks or baseball diamonds. In addition, the proposed cover will not be aesthetically pleasing. Therefore, the community reuse groups may have trouble developing the land around the site for commercial use. The Air Force should consider the long term effects if this action on the reuse of the Base. The IGA Group requests the Air Force and regulatory agencies consider the use of a cap that would allow for reuse of the land in some fashion such as a park or a parking lot but is still protective of human health and the environment.

Response: *Due to the unknown nature of the buried waste at the Landfill and the unknown stability of the trenches used to create the Landfill, reuse of this land in the manner suggested would not be the most protective remedy for human health and the environment. The cover chosen for the Landfill was reviewed and accepted by all Technical Working Group (TWG) and TRC members. It was designed to discourage intrusion and not be aesthetically pleasing. These factors in conjunction with the fence which will surround the Landfill will be further protective of human health and the environment by discouraging entry onto the site by juveniles and adults. A modification to the proposed final remedy for the Landfill does not appear to be prudent at this time.*

The second public comment period on the proposed plan for cleanup of OU-1 was held from January 28, 1993 to February 28, 1994. Comments received during this comment period are summarized below.

<u>Questions received at the Second Public Meeting</u>

Question 1: What is the direction and speed of flow of the groundwater at the landfill?

Answer: *The direction, as indicated on the slide, is generally west to east and the speed is 10^{-4} centimeters per second.*

Question 2: Is there a chance of groundwater at the Landfill being contaminated by contaminants from off Base?

Answer: *To this date, a well installed upgradient of the Landfill has only had samples taken in which no contamination was detected.*

Question 3: Can groundwater from OU-1 contaminate other areas?

Answer: *The OU-1 groundwater will not contaminate other areas. The Air Force's semiannual monitoring program will continue for 30 years under the OU-1 Record of Decision and part of that monitoring program involves analysis of those results to determine what is happening on a continuing basis.*

11.4 Community Relations Activities at Williams AFB

Community relations activities at Williams AFB have been guided by a written Community Relations Plan. Design of the site-specific community relations plan was driven by the level and types of concern expressed by local community members in one-on-one interviews conducted in November 1989.

An information repository containing correspondence, fact sheets, and other pertinent documents, such as the Community Relations Plan, has been established and maintained at the Chandler Public Library, 75 East Commonwealth, Chandler, Arizona 85225, Reference Desk: (602) 786-2310, and the Air Force Base Conversion Agency, 6001 S. Powers Road, Building 1, Mesa, Arizona 85206, Dr. William Harris: (602) 988-6486.

A Technical Review Committee has provided review and comment on actions and proposed actions with respect to releases and threatened releases of hazardous substances at Williams AFB until it was replaced by the Restoration Advisory Board (RAB), established on February 10, 1994. Additionally, the Technical Review Committee served as an advisory committee to the USAF on the IRP at Williams AFB. The Committee, whose membership includes representatives of the USAF, state and federal regulatory agencies, and the community, meets quarterly to discuss the results of the field investigations and studies and to discuss proposals for interim or final cleanup actions. The RAB will cover not only IRP topics but Base reuse topics as well. Membership for this Board is currently being solicited.

Eight fact sheets have been written and distributed to describe ongoing, completed, and planned activities under the IRP at Williams AFB. Six of these were information updates on progress of environmental investigation. Two others described Proposed Plans for cleanup of OU-1 and OU-2.

A 35-mm slide presentation describing the IRP was developed for Base official use with community and civic groups. Before the training wing was de-activated, the Commander or his designee had briefed numerous groups about environmental activities at Williams AFB.

News releases and public notices have been submitted to the local papers announcing milestones in the IRP. Topics include:

- Signing of the FFA
- Availability for comment on EE/CA for the Radioactive Instrumentation Burial Area, the Fire Protection Training Area 1, and the Pesticide Burial Area
- Availability of OU-2 RI Report for review
- Availability of the Proposed Plan for OU-2 for public comment
- Public meeting to present the Proposed Plan for OU-2
- Schedule for cleanup of groundwater and deep soils at OU-2 and investigation of stormwater line and soils at OU-3
- Public meetings to present Proposed Plan for OU-1.

Fact sheets describing the Proposed Plans to clean up OU-1 and OU-2 were mailed to the mailing list contained in the Community Relations Plan, along with the announcement of the public comment period and the public meeting. Broadcast media also received a public service announcement giving the time and location of the public meeting. Notices in the *Arizona Republic* and *Phoenix Gazette* announced the public comment periods for each Proposed Plan and invited the public to the meetings.

Three public meetings have been held at the Mesa Rendezvous Center as part of the Community Relations Program at Williams AFB. Fifty to 75 citizens attended the first meeting held on June 16, 1992 to present the Proposed Plan for cleanup of OU-2, and less than 20 citizens attended the second and third public meetings held October 14, 1993, and February 10, 1994, to present the Proposed Plan for cleanup of OU-1. At each public meeting, attendees were given an agenda, a fact sheet, and graphic representations of cleanup alternatives as handouts. Copies of the Feasibility Study and Proposed Plan were available for review. Press packets, including the handouts, hard copies of slides, and the news releases, were available for media representatives who attended the meeting.

11.5 Letters Recommending Methods and Products

No letters have been received to date requesting consideration of specific methods and products in the remediation of contaminants at OU-1. Any received prior to final publication of this document will be enclosed in this section or an appendix and replies will be sent stating that the method or product can only be considered in the remedial design or remedial action (i.e., cleanup) phase.

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APPENDIX A

RISK ASSESSMENT REEVALUATION

APPENDIX A.1

RISK ASSESSMENT SUMMARY TABLES FROM OU-1 RI ADDENDUM

Table A.1-1

Summary of Risk Characterization Results
Landfill (LF-04)
Williams Air Force Base

Exposure Pathway	Total Hazard Index	Primary Contributor(s)	Total ILCR	Primary Contributor(s)
Current and Future Residential Scenarios				
Ingestion of Groundwater[a]	6.71×10^{0}	Antimony, chromium	7.48×10^{-5}	Beryllium, benzene
Inhalation of Volatiles from Groundwater[a]	1.16×10^{-4}	Carbon disulfide	1.76×10^{-8}	Benzene
Dermal Contact with Groundwater[a]	1.61×10^{-4}	Chromium	1.20×10^{-7}	Beryllium
Total Groundwater HI and ILCR:	6.70×10^{0}		7.49×10^{-5}	
Dermal Contact with Soil	1.07×10^{-1}	Dieldrin, 1,2,4-trichloro-benzene	6.13×10^{-6}	Dieldrin
Incidental Ingestion of Soil	1.21×10^{0}	Lead	1.38×10^{-5}	Beryllium
Inhalation of Fugitive Dust	2.90×10^{-3}	Lead	3.59×10^{-7}	Beryllium
Inhalation of Volatiles from Soil	Not quantified[b]		Not quantified[b]	
Total Soil HI and ILCR:	1.32×10^{0}		2.03×10^{-5}	

Table A.1-1

(Page 2 of 2)

Exposure Pathway	Total Hazard Index	Primary Contributor(s)	Total ILCR	Primary Contributor(s)
Current Occupational Scenario				
Dermal Contact with Soil	8.04×10^{-3}	Dieldrin	1.92×10^{-6}	Dieldrin
Incidental Ingestion of Soil	4.63×10^{-2}	Lead	2.21×10^{-6}	Beryllium
Inhalation of Fugitive Dust	2.07×10^{-3}	Lead	8.88×10^{-6}	Arsenic, chromium
Inhalation of Volatiles from Soil	Not quantified[b]		Not quantified[b]	
Total Soil HI and ILCR:	5.64×10^{-2}		1.30×10^{-5}	

[a]Applies only to future scenario.
[b]Not quantified because no volatile organic compounds were detected in landfill soils.

Table A.1-2

Summary of Risk Characterization Results
Fire Protection Training Area No. 1 (FT-03)
Williams Air Force Base

(Page 1 of 2)

Exposure Pathway	Total Hazard Index	Primary Contributor(s)	Total ILCR	Primary Contributor(s)
Current and Future Residential Scenarios				
Ingestion of Groundwater[a]	7.52×10^{-1}	Cadmium, lead, zinc	2.39×10^{-7}	Methylene chloride
Inhalation of Volatiles from Groundwater[a]	8.90×10^{-5}	Carbon disulfide	1.24×10^{-10}	Methylene chloride
Dermal Contact with Groundwater[a]	1.42×10^{-3}	Cadmium, lead, zinc	1.95×10^{-9}	Methylene chloride
Total Groundwater HI and ILCR:	7.54×10^{-1}		2.41×10^{-7}	
Dermal Contact with Soil	3.19×10^{-3}	Methyl ethyl ketone	8.88×10^{-8}	1,4-Dichlorobenzene
Incidental Ingestion of Soil	1.37×10^{0}	Antimony	1.17×10^{-8}	1,4-Dichlorobenzene
Inhalation of Fugitive Dust	3.02×10^{-3}	Antimony	8.94×10^{-11}	Bis(2-ethylhexyl)phthalate
Inhalation of Volatiles from Soil	6.45×10^{-3}	Methyl ethyl ketone	7.43×10^{-7}	Methylene chloride
Total Soil HI and ILCR:	1.38×10^{0}		8.45×10^{-7}	

Table A.1-2

(Page 2 of 2)

Exposure Pathway	Total Hazard Index	Primary Contributor(s)	Total ILCR	Primary Contributor(s)
Current Occupational Scenario				
Dermal Contact with Soil	2.40×10^{-4}	Methyl ethyl ketone	2.79×10^{-8}	Methylene chloride
Incidental Ingestion of Soil	5.24×10^{-2}	Antimony	1.86×10^{-9}	1,4-Dichlorobenzene
Inhalation of Fugitive Dust	2.16×10^{-3}	Antimony	5.34×10^{-11}	Bis(2-ethylhexyl)phthalate
Inhalation of Volatiles from Soil	4.62×10^{-3}	Methyl ethyl ketone	4.44×10^{-7}	Methylene chloride
Total Soil HI and ILCR:	5.94×10^{-2}		4.72×10^{-7}	

[a]Applies only to future scenario.

Table A.1-3

Summary of Risk Characterization Results
Northwest Drainage System (SD-10)
Williams Air Force Base

Exposure Pathway	Total Hazard Index	Primary Contributor(s)	Total ILCR	Primary Contributor(s)
Current and Future Residential Scenarios				
Dermal Contact with Soil	1.26×10^{-2}	Bis(2-ethylhexyl)phthalate	2.80×10^{-7}	Bis(2-ethylhexyl)phthalate
Incidental Ingestion of Soil	6.55×10^{-1}	Lead, Antimony	4.51×10^{-6}	Beryllium
Inhalation of Fugitive Dust	1.44×10^{-3}	Lead	1.05×10^{-5}	Chromium
Inhalation of Volatiles from Soil	1.02×10^{-2}	Chloroform	3.62×10^{-6}	Chloroform
Total Soil HI and ILCR:	6.79×10^{-1}		1.86×10^{-5}	
Current Occupational Scenario				
Dermal Contact with Soil	1.01×10^{-3}	Bis(2-ethylhexyl)phthalate, chloroform	1.02×10^{-7}	Bis(2-ethylhexyl)phthalate, tetrachloroethene
Incidental Ingestion of Soil	2.51×10^{-2}	Lead	7.91×10^{-7}	Beryllium
Inhalation of Fugitive Dust	1.03×10^{-3}	Lead, antimony	6.31×10^{-6}	Chromium
Inhalation of Volatiles from Soil	7.26×10^{-3}	Chloroform	2.15×10^{-6}	Chloroform
Total Soil HI and ILCR:	3.44×10^{-2}		9.35×10^{-6}	

Table A.1-4

Summary of Risk Characterization Results
Pesticide Burial Area (DP-13)
Williams Air Force Base

Exposure Pathway	Total Hazard Index	Primary Contributor(s)	Total ILCR	Primary Contributor(s)
Current and Future Residential Scenarios				
Dermal Contact with Soil	5.21×10^{-4}	Bis(2-ethylhexyl)phthalate	1.21×10^{-8}	Bis(2-ethylhexyl)phthalate
Incidental Ingestion of Soil	8.16×10^{-1}	Lead, antimony	1.27×10^{-9}	Bis(2-ethylhexyl)phthalate
Inhalation of Fugitive Dust	3.85×10^{-3}	Lead, antimony	4.54×10^{-11}	Bis(2-ethylhexyl)phthalate
Inhalation of Volatiles from Soil	8.21×10^{-2}	Acetone	NA[a]	NA
Total Soil HI and ILCR:	9.03×10^{-1}		1.34×10^{-8}	
Current Occupational Scenario				
Dermal Contact with Soil	3.92×10^{-5}	Bis(2-ethylhexyl)phthalate	3.78×10^{-9}	Bis(2-ethylhexyl)phthalate
Incidental Ingestion of Soil	6.55×10^{-2}	Lead, antimony	2.03×10^{-10}	Bis(2-ethylhexyl)phthalate
Inhalation of Fugitive Dust	3.76×10^{-3}	Antimony	2.70×10^{-11}	Bis(2-ethylhexyl)phthalate
Inhalation of Volatiles from Soil	5.86×10^{-2}	Acetone	NA	NA
Total Soil HI and ILCR:	1.28×10^{-1}		4.01×10^{-9}	

[a]NA - Not applicable; no volatile organic carcinogens were detected at this site.

Table A.1-5

Summary of Risk Characterization Results
Hazardous Materials Storage Area (SS-01)
Williams Air Force Base

Exposure Pathway	Total Hazard Index	Primary Contributor(s)	Total ILCR	Primary Contributor(s)
Current and Future Residential Scenarios				
Dermal Contact with Soil	1.07×10^{-3}	Methylene chloride	3.30×10^{-8}	Methylene chloride
Incidental Ingestion of Soil	4.24×10^{-1}	Lead	5.19×10^{-6}	Beryllium
Inhalation of Fugitive Dust	9.39×10^{-4}	Lead	1.42×10^{-5}	Chromium
Inhalation of Volatiles from Soil	1.65×10^{-4}	Methylene chloride	8.68×10^{-8}	Methylene chloride
Total Soil HI and ILCR:	4.26×10^{-1}		1.94×10^{-5}	
Current Occupational Scenario				
Dermal Contact with Soil	8.08×10^{-5}	Methylene chloride, ethyl benzene	1.04×10^{-8}	Methylene chloride
Incidental Ingestion of Soil	1.61×10^{-2}	Lead	8.28×10^{-7}	Beryllium
Inhalation of Fugitive Dust	7.09×10^{-4}	Lead	8.49×10^{-6}	Chromium
Inhalation of Volatiles from Soil	1.18×10^{-4}	Methylene chloride	5.17×10^{-8}	Methylene chloride
Total Soil HI and ILCR:	1.70×10^{-2}		9.32×10^{-6}	

Table A.1-6

Summary of Risk Characterization Results
Building 789 USTs (ST-05)
Williams Air Force Base

Exposure Pathway	Total Hazard Index	Primary Contributor(s)	Total ILCR	Primary Contributor(s)
Future Residential Scenario				
Dermal Contact with Soil	3.23×10^{-3}	Ethyl benzene	NA[a]	NA
Incidental Ingestion of Soil	6.30×10^{-4}	Ethyl benzene	NA	NA
Inhalation of Fugitive Dust	2.27×10^{-5}	Xylenes	NA	NA
Inhalation of Volatiles from Soil	1.18×10^{-3}	Xylenes	NA	NA
Total Soil HI and ILCR:	5.06×10^{-3}			
Future Construction Scenario				
Dermal Contact with Soil	2.01×10^{-5}	Xylenes	NA	NA
Incidental Ingestion of Soil	2.06×10^{-5}	Xylenes	NA	NA
Inhalation of Fugitive Dust	3.57×10^{-7}	Xylenes	NA	NA
Inhalation of Volatiles from Soil	1.74×10^{-5}	Xylenes	NA	NA
Total Soil HI and ILCR:	5.85×10^{-5}			

Table A.1-6

(Page 2 of 2)

Exposure Pathway	Total Hazard Index	Primary Contributor(s)	Total ILCR	Primary Contributor(s)
Current Occupational Scenario				
Dermal Contact with Soil	2.43×10^{-4}	Ethyl benzene	NA	NA
Incidental Ingestion of Soil	2.41×10^{-5}	Ethyl benzene	NA	NA
Inhalation of Fugitive Dust	1.62×10^{-5}	Xylenes	NA	NA
Inhalation of Volatiles from Soil	8.46×10^{-4}	Xylenes	NA	NA
Total Soil HI and ILCR:	1.13×10^{-3}			

[a]NA - Not applicable; no carcinogenic chemicals of potential concern were found at this site.

Table A.1-7

Summary of Risk Characterization Results
Building 725 USTs (ST-06)
Williams Air Force Base

Exposure Pathway	Total Hazard Index	Primary Contributor(s)	Total ILCR	Primary Contributor(s)
Future Residential Scenario				
Dermal Contact with Soil	3.79×10^{-5}	Ethyl benzene	NA[a]	NA
Incidental Ingestion of Soil	7.24×10^{-6}	Ethyl benzene	NA	NA
Inhalation of Fugitive Dust	1.24×10^{-8}	Xylenes	NA	NA
Inhalation of Volatiles from Soil	2.34×10^{-6}	Xylenes	NA	NA
Total Soil HI and ILCR:	4.75×10^{-5}			
Future Construction Scenario				
Dermal Contact with Soil	1.62×10^{-7}	Ethyl benzene	NA	NA
Incidental Ingestion of Soil	1.66×10^{-7}	Ethyl benzene	NA	NA
Inhalation of Fugitive Dust	2.90×10^{-9}	Ethyl benzene	NA	NA
Inhalation of Volatiles from Soil	5.13×10^{-8}	Ethyl benzene	NA	NA
Total Soil HI and ILCR:	3.82×10^{-7}			

Table A.1-7

(Page 2 of 2)

Exposure Pathway	Total Hazard Index	Primary Contributor(s)	Total ILCR	Primary Contributor(s)
Current Occupational Scenario				
Dermal Contact with Soil	2.85×10^{-6}	Ethyl benzene	NA	NA
Incidental Ingestion of Soil	2.77×10^{-7}	Ethyl benzene	NA	NA
Inhalation of Fugitive Dust	5.28×10^{-9}	Xylenes	NA	NA
Inhalation of Volatiles from Soil	1.68×10^{-6}	Xylenes	NA	NA
Total Soil HI and ILCR:	4.81×10^{-6}			

[a]NA - Not applicable; no carcinogenic chemicals of potential concern were found at this site.

Table A.1-8

Summary of Risk Characterization Results
Building 1086 USTs (ST-07)
Williams Air Force Base

Exposure Pathway	Total Hazard Index	Primary Contributor(s)	Total ILCR	Primary Contributor(s)
Future Residential Scenario				
Dermal Contact with Soil	5.63×10^{-6}	Methylene chloride	2.17×10^{-10}	Methylene chloride
Incidental Ingestion of Soil	1.66×10^{-6}	Methylene chloride	6.41×10^{-11}	Methylene chloride
Inhalation of Fugitive Dust	8.28×10^{-10}	Methylene chloride	5.04×10^{-13}	Methylene chloride
Inhalation of Volatiles from Soil	7.64×10^{-7}	Methylene chloride	4.63×10^{-10}	Methylene chloride
Total Soil HI and ILCR	8.06×10^{-6}		7.45×10^{-10}	
Future Construction Scenario				
Dermal Contact with Soil	2.84×10^{-7}	Methylene chloride	9.17×10^{-13}	Methylene chloride
Incidental Ingestion of Soil	2.92×10^{-7}	Methylene chloride	7.61×10^{-13}	Methylene chloride
Inhalation of Fugitive Dust	5.07×10^{-9}	Methylene chloride	1.64×10^{-14}	Methylene chloride
Inhalation of Volatiles from Soil	4.66×10^{-6}	Methylene chloride	1.50×10^{-11}	Methylene chloride
Total Soil HI and ILCR:	5.24×10^{-6}		1.67×10^{-11}	

Table A.1-8

(Page 2 of 2)

Exposure Pathway	Total Hazard Index	Primary Contributor(s)	Total ILCR	Primary Contributor(s)
Current Occupational Scenario				
Dermal Contact with Soil	5.94×10^{-7}	Methylene chloride	9.55×10^{-11}	Methylene chloride
Incidental Ingestion of Soil	6.36×10^{-8}	Methylene chloride	1.02×10^{-11}	Methylene chloride
Inhalation of Fugitive Dust	5.92×10^{-10}	Methylene chloride	3.00×10^{-13}	Methylene chloride
Inhalation of Volatiles from Soil	5.46×10^{-7}	Methylene chloride	2.76×10^{-10}	Methylene chloride
Total Soil HI and ILCR:	1.20×10^{-6}		3.82×10^{-10}	

Table A.1-9

Summary of Risk Characterization Results
Building 1085 USTs (ST-08)
Williams Air Force Base

Exposure Pathway	Total Hazard Index	Primary Contributor(s)	Total ILCR	Primary Contributor(s)
Future Residential Scenario				
Dermal Contact with Soil	8.50×10^{-4}	Bis(2-ethylhexyl)phthalate	1.90×10^{-8}	Bis(2-ethylhexyl)phthalate
Incidental Ingestion of Soil	2.44×10^{0}	Antimony	2.00×10^{-9}	Bis(2-ethylhexyl)phthalate
Inhalation of Fugitive Dust	5.21×10^{-3}	Antimony	2.90×10^{-5}	Cadmium
Inhalation of Volatiles from Soil	6.77×10^{-3}	Acetone	NA [a]	NA
Total Soil HI and ILCR:	2.45×10^{0}		2.90×10^{-5}	
Future Construction Scenario				
Dermal Contact with Soil	2.83×10^{-5}	Bis(2-ethylhexyl)phthalate	2.86×10^{-11}	Bis(2-ethylhexyl)phthalate
Incidental Ingestion of Soil	2.57×10^{-4}	Antimony	2.94×10^{-11}	Bis(2-ethylhexyl)phthalate
Inhalation of Fugitive Dust	1.52×10^{-6}	Antimony	5.10×10^{-13}	Bis(2-ethylhexyl)phthalate
Inhalation of Volatiles from Soil	2.89×10^{-4}	Acetone	NA	NA
Total Soil HI and ILCR:	5.76×10^{-4}		5.85×10^{-11}	
Current Occupational Scenario				
Dermal Contact with Soil	6.40×10^{-5}	Bis(2-ethylhexyl)phthalate	5.95×10^{-9}	Bis(2-ethylhexyl)phthalate
Incidental Ingestion of Soil	1.63×10^{-2}	Antimony	3.18×10^{-10}	Bis(2-ethylhexyl)phthalate
Inhalation of Fugitive Dust	2.23×10^{-3}	Antimony	1.36×10^{-7}	Cadmium
Inhalation of Volatiles from Soil	4.83×10^{-3}	Acetone	NA	NA
Total Soil ILCR:	2.34×10^{-2}		1.42×10^{-7}	

[a]NA - Not applicable; no volatile organic carcinogens were detected at this site.

APPENDIX A.2

EPA REGION IX OU-1 RISK ASSESSMENT CONFIRMATION MEMO

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IX

75 Hawthorne Street
San Francisco, Ca. 94105-3901

2/7/94

MEMORANDUM

From: Ramon C. Mendoza, Remedial Project Manager, United States Environmental Protection Agency (USEPA) Region 9

To: Dr. William L. Harris, Environmental Coordinator, Williams Air Force Base (WAFB)

Subject: Reassessment of Operable Unit (OU)- 1 Risk Assessment (RI Report, 10/92) regarding metals

The Air Force reevaluated the risk assessment (RA) for OU-1 based on the base-specific surface background data rather than the regional background data (draft final RIR Addendum, 1/94). Because of the limited amount of base-specific data available, we believe this approach may not be sufficient to ensure protection.

We reassessed the OU-1 risk assessment (RI Report,10/92) and found that some metals were not factored into the RA model because they were within the regional background levels. Because of the uncertainties with the data that is being used for background (site/region), EPA compared the metals that were not factored into the OU-1 RA with EPA Region 9 Preliminary Remediation Goals (Enclosure II) and determined the cancer and noncancer risks. These risks were then added to the risk from the OU-1 RA so that an estimated cumulative risk could be calculated.

As part of our conservative approach in determining risk, we used a residential scenario. In addition: Risks were calculated for metals that exceeded EPA PRGs even if they were within regional background levels; Highest concentrations were used in calculating the cancer risk and hazard quotient regardless of the depth in soil and whether these soils had been removed during previous response actions.

The following OU-1 sites were not considered in our reassessment:

a) RW-11: contaminant of concern was radionuclides.
b) Landfill: cover addresses additional potential surface soil risks.
c) USTs ST-05 and ST-06: These USTs contained diesel, gasoline, and waste oil. The USTs were sampled for TCLP lead and the results were non-detect. In addition, soils were excavated and disposed during the removal actions.

The objective of the exercise was to determine if the proposed remedies for OU-1 are still valid. Based on our analysis and with the available data, we conclude that the remedies proposed for OU-1 are still valid.

Our assessment for OU-1 sites DP-13, FT-03, SD-10, SS-01, ST-08, and ST-07 are enclosed (Enclosure I). If you have any questions, please call me at (415) 744-2407.

cc: Fant, ADEQ
Annis, ADWR
Harris Phd., AFBCA WAFB
Stralka Phd. (Toxicologist), EPA Region 9
file

ENCLOSURE I

In the EPA PRG table, cancer (c) and noncancer (nc) risk-based concentrations were calculated based on a lifetime cancer risk of 10-6 risk and a noncancer hazard quotient (HQ) of 1. For example, the beryllium (Be) residential cancer PRG of .4mg/kg is based on a 10-6 risk. Therefore, a concentration of Be at 1mg/kg would have a cancer risk of 2.5 x 10-6. The Be residential noncancer PRG of 390mg/kg is based on a HQ of 1. 1 mg/kg of Be would have an HQ of 1/390.

EPA Region 9 Residential PRGs:

	Cancer (10-6)	Noncancer (HQ=1)
Beryllium (Be) -	.4mg/kg	390mg/kg
Arsenic (As) -	.97mg/kg	23mg/kg
Antimony (Sb) -	-----	31mg/kg

	Federal MCL	EPA Region 9 (tap water)
Barium (Ba) -	2000ug/l	2600ug/l (nc)
Chromium (Cr) -	100ug/l(Cr total)	180ug/l(nc,CrIV & Compounds)
Antimony (Sb) -	5/10ug/l (proposed)	15ug/l (nc)

1. **Site DP-13** - Beryllium (Be), Antimony (Sb), and Arsenic (As) exceeded EPA residential PRGs. Sb was factored into the OU-1 RA, Be and As were not. The highest concentrations were: 5mg/kg of Be at five feet and 4mg/kg of As at 10 feet.

Cancer risk due to Be (1mg/kg)	-	2.5 x 10-6
Cancer risk due to As (4mg/kg)	-	4.12 x 10-6
Total cancer risk from RI	-	1.34 x 10-8+
Revised total cancer risk	-	6.63 x 10-6

HQ due to Be (1mg/kg)	-	.00256
HQ due to As (4mg/kg)	-	.174
Total HQ from RI	-	.478+
Revised total HQ	-	.654

Conclusion: The revised total cancer and noncancer risks are acceptable. In addition, the soil where the data was taken appears to have been excavated during the removal action. Proposed remedy is still valid.

2. **Site FT-03, RA was not conducted at this site.**

Only Be and Sb exceeded EPA residential PRGs. Be concentrations at the surface are above the EPA residential PRG. The highest concentration of Be detected was 1.7mg/kg (RIR Addendum) which poses a cancer risk of 4.25 x 10-6.

Concentrations of Sb exceeded the EPA residential PRG only at depth (40 to 80 feet). The highest concentration found was 61ppm at 40 feet. No surface samples have exceeded the EPA residential PRG. Any potential groundwater (GW) threat has not been substantiated. Sb has not been detected in GW.

The most recent samples did not detect any Sb. This seems to confirm the Air Force's position that the Sb detects were due to instrument systematic problems in 1989.

Conclusion: The risk for Be is acceptable. Proposed remedy is still valid.

3. **SD-10** - Sb, Be, and As exceeded EPA residential PRGs. Sb and Be had been factored into the OU-1 RA, As was not. Highest concentration of As detected was 5mg/kg.

Cancer risk due to As (5mg/kg)	-	5.15 x 10-6
Total cancer risk OU-1 RI	-	8.55 x 10-6 +
		1.35 x 10-5

HQ due to As (5mg/kg)	-	.217
Total HQ from OU-1 RI	-	.235 +
		.452

Conclusion: Additional potential risk due to As is acceptable. Proposed remedy is still valid.

4. **SS-01** - Be and As exceeded EPA residential PRGs. Be was factored into the RA, As was not. Highest concentration of As detected was 4.7mg/kg.

Cancer risk due to As (4.7mg/kg)	-	4.845 x 10-6
Total cancer risk OU-1 RI	-	6.92 x 10-6 +
		1.177 x 10-5

HQ due to As (5mg/kg)	-	.204
Total HQ from OU-1 RI	-	.031 +
		.235

Conclusion : Additional potential risk due to As is acceptable. Proposed remedy is still valid.

5. **ST-08** - Only Sb(31mg/kg at surface - HQ of 1) exceeded EPA residential PRGs. The area where the soil sample was taken was excavated during the UST removal, addressing the potential risk.

Conclusion: Proposed remedy is still valid.

6. ST-07 - The Air Force sampled at depth for TCLP metals.

Detected Results were:

		Federal MCL	EPA Region 9 PRG (tap water)
Barium	- 957 ug/l	2000 ug/l	2600 ug/l (nc)
Chromium	- 15 ug/l	100 ug/l(Cr total)	180 ug/l(nc, CrIV)

These concentrations are below the EPA PRGs and Federal Maximum Contaminant Levels.

Conclusion: Data does not indicated a threat to GW. Proposed remedy is still valid.

REFERENCES

Smucker Ph.D., Stanford J. 1993. Region IX Preliminary Remediation Goals (PRGs) Fourth Quarter 1993. November.

Williams Air Force Base. 1992. Final Remedial Investigation Report Operable Unit 1 Volume 1 Text. October

Williams Air Force Base. 1992. Final Remedial Investigation Report Operable Unit 1 Volume 2 Appendices A through G. October

1992. Region 9 Environmental Protection Agency Drinking Water Standards and Health Advisory Table. February.

ENCLOSURE II

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, Ca. 94105-3901

February 1, 1994

Subject: Region IX Preliminary Remediation Goals (PRGs) First Half 1994

From: Stanford J. Smucker, Ph.D.
Regional Toxicologist (H-9-3)

To: PRG Table Mailing List

Please find the update to the Region IX PRG tables. The tables have been revised to reflect the most current EPA information. Updates to toxicity values were obtained from IRIS through January 1994 and HEAST through July 1993. Exposure factors have not changed from previous issues and reflect assumptions in RAGS Supplemental Guidance (OSWER Directive 9285.6-03, EPA 1991).

The tables provide useful risk-based information for Region IX risk assessors and managers. However, the tables have no official status and may be in conflict with local state requirements. They should be used only as a predictor of single-contaminant risk estimates for a specific environmental media (soil, air, and tap water).

A contaminant concentration that exceeds a PRG level does not, in itself, mean that there is an unacceptable health threat. However, exceedances should be evaluated further. It is recommended that the reader verify the numbers with a toxicologist because the toxicity/exposure information in the table may contain errors or need to be refined based on further evaluation. If you find an error please send me a note via fax at (415) 744-1916.

To get on the PRG Table Mailing List, please make the request through EPA's project manager working on your site. Another option, to obtain the most recent version of the table, is to download the PRG Reference Tables (including text and physico-chemical information) directly from California Regional Water Board's Bulletin Board System at (510) 286-0404. I have tried it out and found it to be very user friendly.

READING THE PRG REFERENCE TABLE

General Considerations:

The PRG Table can be used for general risk screening purposes for residents and workers. Generally, the maximum concentration (or 95 UCL of the arithmetic mean) should be compared against the PRG concentrations. This comparison should only be performed after an extensive records search and compilation of existing data. As noted, before applying the PRG concentrations to a site, it is important to make sure that the exposure pathways and assumptions contained in the PRGs match those at the site. Region IX PRGs are based on standard EPA assumptions for direct exposures (i.e. ingestion, inhalation, and dermal contact) presented in RAGS Supplemental Guidance; OSWER Directive 9285.6-03). Additional pathways not covered by the PRGs require further evaluation.

If more than a handful of chemicals are present at a site, it is recommended that multiple chemical additivity be considered for screening risks at a site. This can be done fairly simply by summing the ratios of measured concentrations to PRG concentrations (e.g. maximum value/PRG value). Cancer and noncancer based PRGs should be segregated when summing ratios. For carcinogens that also have noncancer endpoints, noncancer PRGs (which, in most cases are not presented in the tables) must also be calculated in addition to the cancer PRGs presented in the tables. For more information on screening site risks, the reader should contact EPA Region IX's Technical Support Section.

In the PRG Table, separate cancer and noncancer concentrations were calculated based on a lifetime cancer risk of 10^{-6} risk and a noncancer hazard quotient of 1. The PRG Table presents the lower of the two values. Generally, PRG concentrations for carcinogens are based on cancer effects and for noncarcinogens are based on noncancer effects. However, additional considerations were necessary for soils. For some noncarcinogens, risk-based PRG concentrations were very high, higher than what is physically possible. In these cases a reasonable "ceiling limit" for the amount of chemical that may be in the soil matrix was estimated. For volatiles, the "ceiling limit" is based on the soil saturation limit ("sat") described below. For nonvolatiles, the "ceiling limit" is set at a maximum value ("max") of roughly 10 percent in soils (i.e. 100,000 mg/kg).

Toxicity Values:

EPA toxicity values, known as "safe" reference doses (RfD) and carcinogenic slope factors (SF) were obtained from IRIS through January 1994, HEAST through July 1993, and ECAO-Cincinnati. The priority among sources of toxicological constants used are as follows: (1) IRIS (indicated by "i"), (2) HEAST ("h"), (3) ECAO-contaminant concentration is at or below soil saturation. If the PRG calculated using VF was greater than the calculated soil saturation ("sat"), the PRG was set equal to "sat" in accordance with Risk Assessment Guidance for Superfund - Part B (EPA, 1991).

Dermal Absorption of Contaminants in Soil:

Much uncertainty surrounds the determination of hazards associated with dermal contact with soils. Acute irritation, sensitization reactions, and/or cancer concerns associated with dermal exposures may need to be considered. However, in most cases there are scientific limitations with evaluating these direct contact exposures quantitatively.

Region IX PRGs do consider dermal absorption of contaminants in soil. For volatiles and inorganics, dermal absorption is considered negligible relative to ingestion and/or inhalation exposures. For semivolatiles, a default of 10% dermal absorption is assumed. At this % absorption, the dermal dose is estimated to equal the ingestion dose, using the best estimate default values in Dermal Exposure Assessment: Principles and Applications (EPA 1992). Therefore, to take into account dermal exposures to semivolatiles in soil, the PRG based on ingestion is simply divided by a factor of 2 (that is, the ingestion dose is doubled to account for dermal exposure).

Chemicals Adsorbed to Airborne Particles:

Inhalation of chemicals adsorbed to respirable particles (PM_{10}) were assessed using a default particulate emission factor (PEF) equal to 4.63×10^9 m^3/kg that relates the contaminant concentration in soil with the concentration of respirable particles in the air due to fugitive dust emissions from contaminated soils. The relationship is derived by Cowherd (1985) for a rapid assessment procedure applicable to a typical hazardous waste site where the surface contamination provides a relatively continuous and constant potential for emission over an extended period of time (e.g. years). **This may not be an appropriate assumption for all sites.**

With the possible exception of cadmium, chromium, and nickel, inhalation of airborne particles does not significantly affect the PRG for soils and therefore is not considered further in this memorandum. As written, the Soil PRG equations do not incorporate a PEF value. To incorporate the PEF in the PRG equation (either the default value or a site-specific value), the user simply substitutes the PEF value for the VF value (see below). For more details regarding specific parameters used in the PEF model, the reader is referred to RAGS Part B (EPA, 1991).

EXPOSURE ASSUMPTIONS

Parameter	Definition (units)	Default
CSF_o	Cancer slope factor oral $(mg/kg\text{-}d)^{-1}$	--
CSF_i	Cancer slope factor inhaled $(mg/kg\text{-}d)^{-1}$	--
RfD_o	Reference dose oral (mg/kg-d)	--
RfD_i	Reference dose inhaled (mg/kg-d)	--
TR	Target cancer risk	10^{-6}
THQ	Target hazard quotient	1
BW_a	Body weight, adult (kg)	70
BW_c	Body weight, child (kg)	15
AT	Averaging time (years of life)	70[a]
IR_a	Air breathed (m^3/day)	20, 15[b]
IR_w	Drinking water ingestion (L/day)	2
IRS_a	Soil ingestion - lifetime resident (mg/day)	100
IRS_c	Soil ingestion - child resident (age 1-6), (mg/day)	200
IRS_o	Soil ingestion - occupational (mg/day)	50
EF_r	Exposure frequency - residential (d/y)	350
EF_o	Exposure frequency - occupational (d/y)	250
ED_r	Exposure duration - residential (years)	30, 6[c]
ED_o	Exposure duration - occupational (years)	25
K	Volatilization factor for water (unitless) (Andelman 1990)	0.5

Footnote:

[a]Seventy years is the averaging time for carcinogens. For noncarcinogens, the averaging time is set equal to the exposure duration (AT = ED).

[b]15 m^3/day is the daily intake rate for indoor air. This assumption is used in the tap water equation on page 8.

[c]Exposure duration for lifetime residents is assumed to be 30 years and for child residents is assumed to be 6 years (age 1 thru 6).

3. **Drinking water**

a. Carcinogens

$$C(ug/L) = \frac{TRxBW_a xATx365d/yx10^3 ug/mg}{EF_r xED_r x[(IR_w xCSF_o) + (KxIR_a xCSF_i)]}$$

b. Non-carcinogens

$$C(ug/L) = \frac{THQxBW_a xED_r x365d/yx10^3 ug/mg}{EF_r xED_r x[(\frac{IR_w}{RfD_o}) + (\frac{KxIR_a}{RfD_i})]}$$

4. **Air**

a. Carcinogens

$$C(ug/m^3) = \frac{TRxBW_a xATx365d/yx10^3 ug/mg}{EF_r xED_r xIR_a xCSF_i}$$

b. Non-carcinogens

$$C(ug/m^3) = \frac{THQxRfD_i xBW_a xED_r x365d/yx10^3 ug/mg}{EF_r xED_r xIR_a}$$

SOIL SATURATION CONCENTRATION (C_{sat})

$$C_{sat} = \frac{(K_d x C_w x \beta) + (C_w x P_w) + (C_w x H' x P_a)}{\beta}$$

Parameter	Definition (units)	Default
C_{sat}	Soil saturation concentration (mg/kg)	--
K_d	Soil-water partition coefficient (L/kg)	K_{oc} x OC
K_{oc}	Organic carbon partition	Chemical-specific
OC	Organic carbon content of soil (fraction)	2% or 0.02
C_w	Upper limit of free moisture in soil (mg/L-water)	S x θ
S	Solubility in water (mg/L-water)	Chemical-specific
β	Soil bulk density (kg/L)	1.5
P_w	Water filled soil porosity	$P_t - P_a$
H'	Henry's Law constant (unitless)	H x 41, where 41 is a conversion factor
P_a	Air-filled soil porosity	$P_t - θβ$
θ	Soil moisture content (kg-water/kg-soil)	10% or 0.1
P_t	Total soil porosity (unitless)	$1 - (β/\rho_s)$
ρ_s	True soil density or particle density (kg/L)	2.65

CONTAMINANT	TOXICITY VALUES				V	PRELIMINARY REMEDIATION GOALS (PRGS)			
	oSF 1/(mg/kg-d)	oRfD (mg/kg-d)	iSF 1/(mg/kg-d)	iRfD (mg/kg-d)	O C	Residential Soil (mg/kg)	Industrial Soil (mg/kg)	Ambient Air (ug/m3)	Tap Water (ug/l)
Acephate	8.7E-03 i	4.0E-03 i	8.7E-03 r	4.0E-03 r	0	9.8E+01 ca**	3.3E+02 ca*	9.8E-01 ca*	9.8E+00 ca*
Acetaldehyde		2.6E-03 r		2.6E-03 i	0	1.0E+02 nc	2.7E+03 nc	9.4E+00 nc	9.5E+01 nc
Acetochlor		2.0E-02 i		2.0E-02 r	0	7.8E+02 nc	2.0E+04 nc	7.3E+01 nc	7.3E+02 nc
Acetone		1.0E-01 i		1.0E-01 r	1	9.2E+03 nc	1.3E+04 nc	3.7E+02 nc	7.7E+02 nc
Acetone cyanohydrin		7.0E-02 h		2.9E-03 h	0	2.7E+03 nc	7.2E+04 nc	1.0E+01 nc	2.6E+03 nc
Acetonitrile		6.0E-03 i		1.4E-02 h	0	2.3E+02 nc	6.1E+03 nc	5.2E+01 nc	2.2E+02 nc
Acetophenone		1.0E-01 i		5.7E-06 x	0	3.9E+03 nc	1.0E+05 nc	2.1E-02 nc	3.7E+03 nc
Acifluorfen		1.3E-02 i		1.3E-02 r	0	5.1E+02 nc	1.3E+04 nc	4.7E+01 nc	4.7E+02 nc
Acrolein		2.0E-02 h		5.7E-06 i	0	7.8E+02 nc	2.0E+04 nc	2.1E-02 nc	7.3E+02 nc
Acrylamide	4.5E+00 i	2.0E-04 i	4.5E+00 i	2.0E-04 r	0	1.9E-01 ca*	6.3E-01 ca	1.9E-03 ca	1.9E-02 ca
Acrylic acid		8.0E-02 i		8.6E-05 i	0	3.1E+03 nc	8.2E+04 nc	3.1E-01 nc	2.9E+03 nc
Acrylonitrile	5.4E-01 i	5.7E-04 r	2.4E-01 i	5.7E-04 i	1	2.6E-01 ca*	4.5E-01 ca*	3.6E-02 ca*	5.9E-02 ca*
Alachlor	8.1E-02 h	1.0E-02 i	8.0E-02 r	1.0E-02 r	0	1.1E+01 ca*	3.6E+01 ca	1.1E-01 ca	1.1E+00 ca
Alar		1.5E-01 i		1.5E-01 r	0	5.9E+03 nc	1.0E+05 max	5.5E+02 nc	5.5E+03 nc
Aldicarb		1.0E-03 i		1.0E-03 r	0	3.9E+01 nc	1.0E+03 nc	3.6E+00 nc	3.7E+01 nc
Aldicarb sulfone		1.0E-03 i		1.0E-03 r	0	3.9E+01 nc	1.0E+03 nc	3.6E+00 nc	3.7E+01 nc
Aldrin	1.7E+01 i	3.0E-05 i	1.7E+01 i	3.0E-05 r	0	5.0E-02 ca*	1.7E-01 ca	5.0E-04 ca	5.0E-03 ca
Ally		2.5E-01 i		2.5E-01 r	0	9.8E+03 nc	1.0E+05 max	9.1E+02 nc	9.1E+03 nc
Allyl alcohol		5.0E-03 x		5.0E-03 r	0	2.0E+02 nc	5.1E+03 nc	1.8E+01 nc	1.8E+02 nc
Allyl chloride		5.0E-02 h		2.9E-04 i	0	2.0E+03 nc	5.1E+04 nc	1.0E+00 nc	1.8E+03 nc
Aluminum		1.0E+00 e			0	7.8E+04 nc	1.0E+05 max		3.7E+04 nc
Aluminum phosphide		4.0E-04 i			0	3.1E+01 nc	8.2E+02 nc		1.5E+01 nc
Amdro		3.0E-04 i		3.0E-04 r	0	1.2E+01 nc	3.1E+02 nc	1.1E+00 nc	1.1E+01 nc
Ametryn		9.0E-03 i		9.0E-03 r	0	3.5E+02 nc	9.2E+03 nc	3.3E+01 nc	3.3E+02 nc
m-Aminophenol		7.0E-02 h		7.0E-02 r	0	2.7E+03 nc	7.2E+04 nc	2.6E+02 nc	2.6E+03 nc
4-Aminopyridine		2.0E-05 h		2.0E-05 r	0	7.8E-01 nc	2.0E+01 nc	7.3E-02 nc	7.3E-01 nc
Amitraz		2.5E-03 i		2.5E-03 r	0	9.8E+01 nc	2.6E+03 nc	9.1E+00 nc	9.1E+01 nc
Ammonia				2.9E-02 i	0			1.0E+02 nc	
Ammonium sulfamate		2.0E-01 i			0	7.8E+03 nc	1.0E+05 max		7.3E+03 nc
Aniline	5.7E-03 i	2.9E-04 r	5.7E-03 r	2.9E-04 i	0	1.1E+01 nc	3.0E+02 nc	1.0E+00 nc	1.1E+01 nc
Antimony and compounds		4.0E-04 i			0	3.1E+01 nc	8.2E+02 nc		1.5E+01 nc
Antimony pentoxide		5.0E-04 h			0	3.9E+01 nc	1.0E+03 nc		1.8E+01 nc
Antimony potassium tartrate		9.0E-04 h			0	7.0E+01 nc	1.8E+03 nc		3.3E+01 nc

Key: i=IRIS h=HEAST e=ECAO x=WITHDRAWN r=ROUTE EXTRAP. t=TOX. EQUIV. ca=CANCER PRG nc=NONCANCER PRG sat=SOIL SAT. max=MAX. LIMIT *=nc < 100X ca **=nc < 10X ca

CONTAMINANT	TOXICITY VALUES oSF 1/(mg/kg-d)	oRfD (mg/kg-d)	iSF 1/(mg/kg-d)	iRfD (mg/kg-d)	VOC	PRELIMINARY REMEDIATION GOALS (PRGS) Residential Soil (mg/kg)	Industrial Soil (mg/kg)	Ambient Air (ug/m3)	Tap Water (ug/l)
Bisphenol A		5.0E-02 i		5.0E-02 r	0	2.0E+03 nc	5.1E+04 nc	1.8E+02 nc	1.8E+03 nc
Boron		9.0E-02 i		5.7E-03 h	0	7.0E+03 nc	9.2E+04 nc	2.1E+01 nc	3.3E+03 nc
Boron trifluoride				2.0E-04 h	0			7.3E-01 nc	
Bromodichloromethane	6.2E-02 i	2.0E-02 i	6.2E-02 r	2.0E-02 r	1	2.9E+00 ca	5.1E+00 ca	1.4E-01 ca	2.9E-01 ca
Bromoethene (vinyl bromide)	1.1E-01 r	8.6E-04 r	1.1E-01 h	8.6E-04 i	1	8.6E-01 ca*	1.5E+00 ca*	7.7E-02 ca*	1.6E-01 ca
Bromoform (tribromomethane)	7.9E-03 i	2.0E-02 i	3.9E-03 i	2.0E-02 r	0	1.1E+02 ca**	3.6E+02 ca*	2.2E+00 ca*	1.1E+01 ca
Bromomethane		1.4E-03 i		1.4E-03 i	1	8.0E+01 nc	8.4E+01 nc	5.2E+00 nc	1.1E+01 nc
4-Bromophenyl phenyl ether					0				
Bromophos		5.0E-03 h		5.0E-03 r	0	2.0E+02 nc	5.1E+03 nc	1.8E+01 nc	1.8E+02 nc
Bromoxynil		2.0E-02 i		2.0E-02 r	0	7.8E+02 nc	2.0E+04 nc	7.3E+01 nc	7.3E+02 nc
Bromoxynil octanoate		2.0E-02 i		2.0E-02 r	0	7.8E+02 nc	2.0E+04 nc	7.3E+01 nc	7.3E+02 nc
1,3-Butadiene	9.8E-01 r		9.8E-01 i		1			8.7E-03 ca	1.8E-02 ca
1-Butanol		1.0E-01 i		1.0E-01 r	0	3.9E+03 nc	1.0E+05 nc	3.7E+02 nc	3.7E+03 nc
Butylate		5.0E-02 i		5.0E-02 r	0	2.0E+03 nc	5.1E+04 nc	1.8E+02 nc	1.8E+03 nc
Butyl benzyl phthalate		2.0E-01 i		2.0E-01 r	0	7.8E+03 nc	1.0E+05 max	7.3E+02 nc	7.3E+03 nc
Butylphthalyl butylglycolate		1.0E+00 i		1.0E+00 r	0	3.9E+04 nc	1.0E+05 max	3.7E+03 nc	3.7E+04 nc
Cacodylic acid		3.0E-03 h		3.0E-03 r	0	1.2E+02 nc	3.1E+03 nc	1.1E+01 nc	1.1E+02 nc
Cadmium and compounds		5.0E-04 i	6.3E+00 i		0	3.9E+01 nc	4.9E+02 nc	1.4E-03 ca	1.8E+01 nc
Caprolactam		5.0E-01 i		5.0E-01 r	0	2.0E+04 nc	1.0E+05 max	1.8E+03 nc	1.8E+04 nc
Captafol	8.6E-03 h	2.0E-03 i	8.6E-03 r	2.0E-03 r	0	7.8E+01 nc	3.3E+02 ca*	9.9E-01 ca*	9.9E+00 ca
Captan	3.5E-03 h	1.3E-01 i	3.5E-03 r	1.3E-01 r	0	2.4E+02 ca*	8.2E+02 ca	2.4E+00 ca	2.4E+01 c
Carbaryl		1.0E-01 i		1.1E-01 r	0	3.9E+03 nc	1.0E+05 nc	4.0E+02 nc	3.7E+03 n
Carbazole	2.0E-02 h		2.0E-02 r		0	4.3E+01 ca	1.4E+02 ca	4.3E-01 ca	4.3E+00 c
Carbofuran		5.0E-03 i		5.0E-03 r	0	2.0E+02 nc	5.1E+03 nc	1.8E+01 nc	1.8E+02 n
Carbon disulfide		1.0E-01 i		2.9E-03 h	1	5.3E+01 nc	7.4E+01 nc	1.0E+01 nc	2.8E+01 n
Carbon tetrachloride	1.3E-01 i	7.0E-04 i	5.2E-02 i	5.7E-04 e	1	9.2E-01 ca*	1.6E+00 ca*	1.6E-01 ca*	2.6E-01 c
Carbosulfan		1.0E-02 i		1.0E-02 r	0	3.9E+02 nc	1.0E+04 nc	3.7E+01 nc	3.7E+02 n
Carboxin		1.0E-01 i		1.0E-01 r	0	3.9E+03 nc	1.0E+05 nc	3.7E+02 nc	3.7E+03 n
Chloral		2.0E-03 i		2.0E-03 r	0	7.8E+01 nc	2.0E+03 nc	7.3E+00 nc	7.3E+01 n
Chloramben		1.5E-02 i		1.5E-02 r	0	5.9E+02 nc	1.5E+04 nc	5.5E+01 nc	5.5E+02 n
Chloranil	4.0E-01 h		4.0E-01 r		0	2.1E+00 ca	7.1E+00 ca	2.1E-02 ca	2.1E-01 c
Chlordane	1.3E+00 i	6.0E-05 i	1.3E+00 i	6.0E-05 r	0	6.6E-01 ca**	2.2E+00 ca*	6.6E-03 ca*	6.6E-02 c
Chlorimuron-ethyl		2.0E-02 i		2.0E-02 r	0	7.8E+02 nc	2.0E+04 nc	7.3E+01 nc	7.3E+02 n

Key: i=IRI :EAST e=ECAO x=WITHDRAWN r=ROUTE EXTRAP. t=TOX. EQUIV. ca=CAN G nc=NONCANCER PRG sat=SOIL SAT. max=MAX. LIMIT *=nc < 100X ca nc < 10X ca

CONTAMINANT	TOXICITY VALUES oSF 1/(mg/kg-d)	oRfD (mg/kg-d)	iSF 1/(mg/kg-d)	iRfD (mg/kg-d)	V O C	PRELIMINARY REMEDIATION GOALS (PRGS) Residential Soil (mg/kg)	Industrial Soil (mg/kg)	Ambient Air (ug/m3)	Tap Water (ug/l)
Coke Oven Emissions			2.2E+00 i		0			3.9E-03 ca	
Copper and compounds		3.7E-02 h			0	2.9E+03 nc	7.6E+04 nc		1.4E+03 nc
Crotonaldehyde	1.9E+00 h	1.0E-02 x	1.9E+00 x	1.0E-02 r	1	2.2E-02 ca	3.7E-02 ca	4.5E-03 ca	9.4E-03 ca
Cumene		4.0E-02 i		2.6E-03 h	1	6.8E+01 sat	6.8E+01 sat	9.4E+00 nc	2.5E+01 nc
Cyanazine	8.4E-01 h	2.0E-03 h	8.4E-01 r	2.0E-03 r	0	1.0E+00 ca*	3.4E+00 ca	1.0E-02 ca	1.0E-01 ca
Cyanides									
Barium cyanide		1.0E-01 h			0	7.8E+03 nc	1.0E+05 max		3.7E+03 nc
Copper cyanide		5.0E-03 i			0	3.9E+02 nc	1.0E+04 nc		1.8E+02 nc
Calcium cyanide		4.0E-02 i			0	3.1E+03 nc	8.2E+04 nc		1.5E+03 nc
Cyanogen		4.0E-02 i			0	3.1E+03 nc	8.2E+04 nc		1.5E+03 nc
Cyanogen bromide		9.0E-02 i			0	7.0E+03 nc	1.0E+05 max		3.3E+03 nc
Cyanogen chloride		5.0E-02 i			0	3.9E+03 nc	1.0E+05 nc		1.8E+03 nc
Free cyanide		2.0E-02 i			0	1.6E+03 nc	4.1E+04 nc		7.3E+02 nc
Hydrogen cyanide		2.0E-02 i			0	1.6E+03 nc	4.1E+04 nc		7.3E+02 nc
Potassium cyanide		5.0E-02 i			0	3.9E+03 nc	1.0E+05 nc		1.8E+03 nc
Potassium silver cyanide		2.0E-01 i			0	1.6E+04 nc	1.0E+05 max		7.3E+03 nc
Silver cyanide		1.0E-01 i			0	7.8E+03 nc	1.0E+05 max		3.7E+03 nc
Sodium cyanide		4.0E-02 i			0	3.1E+03 nc	8.2E+04 nc		1.5E+03 nc
Zinc cyanide		5.0E-02 i			0	3.9E+03 nc	1.0E+05 nc		1.8E+03 nc
Cyclohexanone		5.0E+00 i		5.0E+00 r	0	1.0E+05 max	1.0E+05 max	1.8E+04 nc	1.8E+05 nc
Cyclohexlamine		2.0E-01 i		2.0E-01 r	0	7.8E+03 nc	1.0E+05 max	7.3E+02 nc	7.3E+03 nc
Cyhalothrin/Karate		5.0E-03 i		5.0E-03 r	0	2.0E+02 nc	5.1E+03 nc	1.8E+01 nc	1.8E+02 nc
Cypermethrin		1.0E-02 i		1.0E-02 r	0	3.9E+02 nc	1.0E+04 nc	3.7E+01 nc	3.7E+02 nc
Cyromazine		7.5E-03 i		7.5E-03 r	0	2.9E+02 nc	7.7E+03 nc	2.7E+01 nc	2.7E+02 nc
Dacthal		5.0E-01 i		5.0E-01 r	0	2.0E+04 nc	1.0E+05 max	1.8E+03 nc	1.8E+04 nc
Dalapon		3.0E-02 i		3.0E-02 r	0	1.2E+03 nc	3.1E+04 nc	1.1E+02 nc	1.1E+03 nc
Danitol		5.0E-04 x		5.0E-04 r	0	2.0E+01 nc	5.1E+02 nc	1.8E+00 nc	1.8E+01 nc
DDD	2.4E-01 i		2.4E-01 r		0	3.5E+00 ca	1.2E+01 ca	3.5E-02 ca	3.5E-01 c
DDE	3.4E-01 i		3.4E-01 r		0	2.5E+00 ca	8.4E+00 ca	2.5E-02 ca	2.5E-01 c
DDT	3.4E-01 i	5.0E-04 i	3.4E-01 i	5.0E-04 r	0	2.5E+00 ca**	8.4E+00 ca*	2.5E-02 ca*	2.5E-01 c
Decabromodiphenyl ether		1.0E-02 i		1.0E-02 r	0	3.9E+02 nc	1.0E+04 nc	3.7E+01 nc	3.7E+02 n
Demeton		4.0E-05 i		4.0E-05 r	0	1.6E+00 nc	4.1E+01 nc	1.5E-01 nc	1.5E+00 n
Diallate	6.1E-02 h		6.1E-02 r		0	1.4E+01 ca	4.7E+01 ca	1.4E-01 ca	1.4E+00 c

Key: i=IRIS h=HEAST e=ECAO x=WITHDRAWN r=ROUTE EXTRAP. t=TOX. EQUIV. ca=CANCER PRG nc=NONCANCER PRG sat=SOIL SAT. max=MAX. LIMIT *=nc < 100X ca **=nc < 10X ca

CONTAMINANT	TOXICITY VALUES				V	PRELIMINARY REMEDIATION GOALS (PRGS)			
	oSF 1/(mg/kg-d)	oRfD (mg/kg-d)	iSF 1/(mg/kg-d)	iRfD (mg/kg-d)	O C	Residential Soil (mg/kg)	Industrial Soil (mg/kg)	Ambient Air (ug/m3)	Tap Water (ug/l)
Diethyl phthalate		8.0E-01 i		8.0E-01 r	0	3.1E+04 nc	1.0E+05 max	2.9E+03 nc	2.9E+04 nc
Diethylstilbestrol	4.7E+03 h		4.7E+03 r		0	1.8E-04 ca	6.1E-04 ca	1.8E-06 ca	1.8E-05 ca
Difenzoquat (Avenge)		8.0E-02 i		8.0E-02 r	0	3.1E+03 nc	8.2E+04 nc	2.9E+02 nc	2.9E+03 nc
Diflubenzuron		2.0E-02 i		2.0E-02 r	0	7.8E+02 nc	2.0E+04 nc	7.3E+01 nc	7.3E+02 nc
Diisopropyl methylphosphonate		8.0E-02 i		8.0E-02 r	0	3.1E+03 nc	8.2E+04 nc	2.9E+02 nc	2.9E+03 nc
Dimethipin		2.0E-02 i		2.0E-02 r	0	7.8E+02 nc	2.0E+04 nc	7.3E+01 nc	7.3E+02 n
Dimethoate		2.0E-04 i		2.0E-04 r	0	7.8E+00 nc	2.0E+02 nc	7.3E-01 nc	7.3E+00 n
3,3'-Dimethoxybenzidine	1.4E-02 h		1.4E-02 r		0	6.1E+01 ca	2.0E+02 ca	6.1E-01 ca	6.1E+00 c
Dimethylamine		5.7E-06 r		5.7E-06 x	1	2.4E-01 nc	3.4E-01 nc	2.1E-02 nc	4.4E-02 n
N-N-Dimethylaniline		2.0E-03 i		2.0E-03 r	0	7.8E+01 nc	2.0E+03 nc	7.3E+00 nc	7.3E+01 n
2,4-Dimethylaniline	7.5E-01 h		7.5E-01 r		0	1.1E+00 ca	3.8E+00 ca	1.1E-02 ca	1.1E-01 c
2,4-Dimethylaniline hydrochloride	5.8E-01 h		5.8E-01 r		0	1.5E+00 ca	4.9E+00 ca	1.5E-02 ca	1.5E-01 c
3,3'-Dimethylbenzidine	9.2E+00 h		9.2E+00 r		0	9.3E-02 ca	3.1E-01 ca	9.3E-04 ca	9.3E-03 c
1,1-Dimethylhydrazine	2.6E+00 h		3.5E+00 h		0	3.3E-01 ca	1.1E+00 ca	2.4E-03 ca	3.3E-02 c
1,2-Dimethylhydrazine	3.7E+01 x		3.7E+01 x		0	2.3E-02 ca	7.7E-02 ca	2.3E-04 ca	2.3E-03 c
N,N-Dimethylformamide		1.0E-01 h		8.6E-03 i	0	3.9E+03 nc	1.0E+05 nc	3.1E+01 nc	3.7E+03 n
2,4-Dimethylphenol		2.0E-02 i		2.0E-02 r	0	7.8E+02 nc	2.0E+04 nc	7.3E+01 nc	7.3E+02 n
2,6-Dimethylphenol		6.0E-04 i		6.0E-04 r	0	2.3E+01 nc	6.1E+02 nc	2.2E+00 nc	2.2E+01 n
3,4-Dimethylphenol		1.0E-03 i		1.0E-03 r	0	3.9E+01 nc	1.0E+03 nc	3.6E+00 nc	3.7E+01 n
Dimethyl phthalate		1.0E+01 h		1.0E+01 r	0	1.0E+05 max	1.0E+05 max	3.7E+04 nc	3.7E+05 n
Dimethyl terephthalate		1.0E-01 i		1.0E-01 r	0	3.9E+03 nc	1.0E+05 nc	3.7E+02 nc	3.7E+03
4,6-Dinitro-o-cyclohexyl phenol		2.0E-03 i		2.0E-03 r	0	7.8E+01 nc	2.0E+03 nc	7.3E+00 nc	7.3E+01
1,3-Dinitrobenzene		1.0E-04 i		1.0E-04 r	0	3.9E+00 nc	1.0E+02 nc	3.6E-01 nc	3.7E+00
1,2-Dinitrobenzene		4.0E-04 h		4.0E-04 r	0	1.6E+01 nc	4.1E+02 nc	1.5E+00 nc	1.5E+01
1,4-Dinitrobenzene		4.0E-04 h		4.0E-04 r	0	1.6E+01 nc	4.1E+02 nc	1.5E+00 nc	1.5E+01
2,4-Dinitrophenol		2.0E-03 i		2.0E-03 r	0	7.8E+01 nc	2.0E+03 nc	7.3E+00 nc	7.3E+01
Dinitrotoluene mixture	6.8E-01 i		6.8E-01 r		0	1.3E+00 ca	4.2E+00 ca	1.3E-02 ca	1.3E-01
2,4-Dinitrotoluene		2.0E-03 i		2.0E-03 r	0	7.8E+01 nc	2.0E+03 nc	7.3E+00 nc	7.3E+01
2,6-Dinitrotoluene	6.8E-01 i	1.0E-03 h	6.8E-01 r	1.0E-03 r	0	1.3E+00 ca*	4.2E+00 ca	1.3E-02 ca	1.3E-01
Dinoseb		1.0E-03 i		1.0E-03 r	0	3.9E+01 nc	1.0E+03 nc	3.6E+00 nc	3.7E+01
di-n-Octyl phthalate		2.0E-02 h		2.0E-02 r	0	7.8E+02 nc	2.0E+04 nc	7.3E+01 nc	7.3E+02
1,4-Dioxane	1.1E-02 i		1.1E-02 r		1	3.2E+01 ca	6.0E+01 ca	7.7E-01 ca	1.6E+00
Diphenamid		3.0E-02 i		3.0E-02 r	0	1.2E+03 nc	3.1E+04 nc	1.1E+02 nc	1.1E+03

Key: i=IR HEAST e=ECAO x=WITHDRAWN r=ROUTE EXTRAP. t=TOX. EQUIV. ca=CA RG nc=NONCANCER PRG sat=SOIL SAT. max=MAX. LIMIT *=nc < 100X c =nc < 10X ca

CONTAMINANT	TOXICITY VALUES oSF 1/(mg/kg-d)	oRfD (mg/kg-d)	iSF 1/(mg/kg-d)	iRfD (mg/kg-d)	V O C	PRELIMINARY REMEDIATION GOALS (PRGS) Residential Soil (mg/kg)	Industrial Soil (mg/kg)	Ambient Air (ug/m3)	Tap Water (ug/l)
Ethylphthalyl ethyl glycolate		3.0E+00 i		3.0E+00 r	0	1.0E+05 max	1.0E+05 max	1.1E+04 nc	1.1E+05 nc
Express		8.0E-03 i		8.0E-03 r	0	3.1E+02 nc	8.2E+03 nc	2.9E+01 nc	2.9E+02 nc
Fenamiphos		2.5E-04 i		2.5E-04 r	0	9.8E+00 nc	2.6E+02 nc	9.1E-01 nc	9.1E+00 nc
Fluometuron		1.3E-02 i		1.3E-02 r	0	5.1E+02 nc	1.3E+04 nc	4.7E+01 nc	4.7E+02 nc
Fluoride		6.0E-02 i		6.0E-02 r	0	2.3E+03 nc	6.1E+04 nc	2.2E+02 nc	2.2E+03 nc
Fluoridone		8.0E-02 i		8.0E-02 r	0	3.1E+03 nc	8.2E+04 nc	2.9E+02 nc	2.9E+03 n
Flurprimidol		2.0E-02 i		2.0E-02 r	0	7.8E+02 nc	2.0E+04 nc	7.3E+01 nc	7.3E+02 n
Flutolanil		6.0E-02 i		6.0E-02 r	0	2.3E+03 nc	6.1E+04 nc	2.2E+02 nc	2.2E+03 n
Fluvalinate		1.0E-02 i		1.0E-02 r	0	3.9E+02 nc	1.0E+04 nc	3.7E+01 nc	3.7E+02 n
Folpet	3.5E-03 i	1.0E-01 i	3.5E-03 r	1.0E-01 r	0	2.4E+02 ca*	8.2E+02 ca	2.4E+00 ca	2.4E+01 c
Fomesafen	1.9E-01 i		1.9E-01 r		0	4.5E+00 ca	1.5E+01 ca	4.5E-02 ca	4.5E-01 c
Fonofos		2.0E-03 i		2.0E-03 r	0	7.8E+01 nc	2.0E+03 nc	7.3E+00 nc	7.3E+01 n
Formaldehyde	4.5E-02 r	2.0E-01 i	4.5E-02 i	2.0E-01 r	0	1.9E+01 ca	6.3E+01 ca	1.9E-01 ca	1.9E+00 c
Formic Acid		2.0E+00 h		2.0E+00 r	0	7.8E+04 nc	1.0E+05 max	7.3E+03 nc	7.3E+04 n
Fosetyl-al		3.0E+00 i		3.0E+00 r	0	1.0E+05 max	1.0E+05 max	1.1E+04 nc	1.1E+05 n
Furan		1.0E-03 i		1.0E-03 r	0	3.9E+01 nc	1.0E+03 nc	3.6E+00 nc	3.7E+01 n
Furazolidone	3.8E+00 h				0	2.2E-01 ca	7.5E-01 ca	1.0E+09 ca	2.2E-02 c
Furfural		3.0E-03 i		1.4E-02 h	0	1.2E+02 nc	3.1E+03 nc	5.2E+01 nc	1.1E+02 n
Furium	5.0E+01 h		5.0E+01 r		0	1.7E-02 ca	5.7E-02 ca	1.7E-04 ca	1.7E-03 c
Furmecyclox	3.0E-02 i		3.0E-02 r		0	2.8E+01 ca	9.5E+01 ca	2.8E-01 ca	2.8E+00 c
Glufosinate-ammonium		4.0E-04 i		4.0E-04 r	0	1.6E+01 nc	4.1E+02 nc	1.5E+00 nc	1.5E+01 n
Glycidaldehyde		4.0E-04 i		2.9E-04 h	0	1.6E+01 nc	4.1E+02 nc	1.0E+00 nc	1.5E+01 n
Glyphosate		1.0E-01 i		1.0E-01 r	0	3.9E+03 nc	1.0E+05 nc	3.7E+02 nc	3.7E+03 n
Haloxyfop-methyl		5.0E-05 i		5.0E-05 r	0	2.0E+00 nc	5.1E+01 nc	1.8E-01 nc	1.8E+00
Harmony		1.3E-02 i		1.3E-02 r	0	5.1E+02 nc	1.3E+04 nc	4.7E+01 nc	4.7E+02
Heptachlor	4.5E+00 i	5.0E-04 i	4.5E+00 i	5.0E-04 r	0	1.9E-01 ca	6.4E-01 ca	1.9E-03 ca	1.9E-02
Heptachlor epoxide	9.1E+00 i	1.3E-05 i	9.1E+00 i	1.3E-05 r	0	9.4E-02 ca**	3.1E-01 ca*	9.4E-04 ca*	9.4E-03
Hexabromobenzene		2.0E-03 i		2.0E-03 r	0	7.8E+01 nc	2.0E+03 nc	7.3E+00 nc	7.3E+01
Hexachlorobenzene	1.6E+00 i	8.0E-04 i	1.6E+00 i	8.0E-04 r	0	5.3E-01 ca*	1.8E+00 ca	5.3E-03 ca	5.3E-02
Hexachlorobutadiene	7.8E-02 i	2.0E-03 x	7.7E-02 i	2.0E-03 r	0	1.1E+01 ca**	3.7E+01 ca*	1.1E-01 ca*	1.1E+00
HCH (alpha)	6.3E+00 i		6.3E+00 i		0	1.4E-01 ca	4.5E-01 ca	1.4E-03 ca	1.4E-02
HCH (beta)	1.8E+00 i		1.8E+00 i		0	4.7E-01 ca	1.6E+00 ca	4.7E-03 ca	4.7E-02
HCH (gamma) Lindane	1.3E+00 h	3.0E-04 i	1.3E+00 r	3.0E-04 r	0	6.6E-01 ca*	2.2E+00 ca	6.6E-03 ca	6.6E-02

Key: i=IRIS h=HEAST e=ECAO x=WITHDRAWN r=ROUTE EXTRAP. t=TOX. EQUIV. ca=CANCER PRG nc=NONCANCER PRG sat=SOIL SAT. max=MAX. LIMIT *=nc < 100X ca **=nc < 10X ca

CONTAMINANT	TOXICITY VALUES oSF 1/(mg/kg-d)	oRfD (mg/kg-d)	iSF 1/(mg/kg-d)	iRfD (mg/kg-d)	VOC	PRELIMINARY REMEDIATION GOALS (PRGS) Residential Soil (mg/kg)	Industrial Soil (mg/kg)	Ambient Air (ug/m3)	Tap Water (ug/l)
Mephosfolan		9.0E-05 h		9.0E-05 r	0	3.5E+00 nc			
Mepiquat		3.0E-02 i		3.0E-02 r	0	1.2E+03 nc			
Mercury and compounds (methyl)		3.0E-04 i			0	1.2E+01 nc			
Mercury and compounds (inorganic)		3.0E-04 h		8.6E-05 h	0	2.3E+01 nc	6.1E+02 nc	3.1E-01 nc	1.1E+01 nc
Merphos		3.0E-05 i		3.0E-05 r	0	1.2E+00 nc	3.1E+01 nc	1.1E-01 nc	1.1E+00 nc
Merphos oxide		3.0E-05 i		3.0E-05 r	0	1.2E+00 nc	3.1E+01 nc	1.1E-01 nc	1.1E+00 nc
Metalaxyl		6.0E-02 i		6.0E-02 r	0	2.3E+03 nc	6.1E+04 nc	2.2E+02 nc	2.2E+03 nc
Methacrylonitrile		1.0E-04 i		2.0E-04 h	1	5.6E+00 nc	7.8E+00 nc	7.3E-01 nc	1.3E+00 nc
Methamidophos		5.0E-05 i		5.0E-05 r	0	2.0E+00 nc	5.1E+01 nc	1.8E-01 nc	1.8E+00 nc
Methanol		5.0E-01 i		5.0E-01 r	0	2.0E+04 nc	1.0E+05 max	1.8E+03 nc	1.8E+04 nc
Methidathion		1.0E-03 i		1.0E-03 r	0	3.9E+01 nc	1.0E+03 nc	3.6E+00 nc	3.7E+01 nc
Methomyl		2.5E-02 i		2.5E-02 r	0	9.8E+02 nc	2.6E+04 nc	9.1E+01 nc	9.1E+02 n
Methoxychlor		5.0E-03 i		5.0E-03 r	0	2.0E+02 nc	5.1E+03 nc	1.8E+01 nc	1.8E+02 n
2-Methoxyethanol		1.0E-03 h		5.7E-03 i	0	3.9E+01 nc	1.0E+03 nc	2.1E+01 nc	3.7E+01 n
2-Methoxyethanol acetate		2.0E-03 h		2.0E-03 r	0	7.8E+01 nc	2.0E+03 nc	7.3E+00 nc	7.3E+01 n
2-Methoxy-5-nitroaniline	4.6E-02 h		4.6E-02 r		0	1.9E+01 ca	6.2E+01 ca	1.9E-01 ca	1.9E+00 c
Methyl acetate		1.0E+00 h		1.0E+00 r	1	9.4E+04 nc	1.3E+05 nc	3.7E+03 nc	6.1E+03 n
Methyl acrylate		3.0E-02 h		3.0E-02 r	1	1.1E+02 sat	1.1E+02 sat	1.1E+02 nc	2.3E+02 n
2-Methylaniline (o-toluidine)	2.4E-01 h		2.4E-01 r		0	3.5E+00 ca	1.2E+01 ca	3.5E-02 ca	3.5E-01 c
2-Methylaniline hydrochloride	1.8E-01 h		1.8E-01 r		0	4.7E+00 ca	1.6E+01 ca	4.7E-02 ca	4.7E-01 c
Methyl chlorocarbonate		1.0E+00 x		1.0E+00 r	0	3.9E+04 nc	1.0E+05 max	3.7E+03 nc	3.7E+04 r
2-Methyl-4-chlorophenoxyacetic acid		5.0E-04 i		5.0E-04 r	0	2.0E+01 nc	5.1E+02 nc	1.8E+00 nc	1.8E+01 r
4-(2-Methyl-4-chlorophenoxy) butyric acid (MCPB)		1.0E-02 i		1.0E-02 r	0	3.9E+02 nc	1.0E+04 nc	3.7E+01 nc	3.7E+02 r
2-(2-Methyl-4-chlorophenoxy) propionic acid		1.0E-03 i		1.0E-03 r	0	3.9E+01 nc	1.0E+03 nc	3.6E+00 nc	3.7E+01 r
2-(2-Methyl-1,4-chlorophenoxy) propionic acid (MCPP)		1.0E-03 i		1.0E-03 r	0	3.9E+01 nc	1.0E+03 nc	3.6E+00 nc	3.7E+01 r
Methylcyclohexane		8.6E-01 r		8.6E-01 h	0	3.4E+04 nc	1.0E+05 max	3.1E+03 nc	3.1E+04 r
4,4'-Methylenediphenyl isocyanate		5.7E-06 r		5.7E-06 h	0	2.2E-01 nc	5.8E+00 nc	2.1E-02 nc	2.1E-01 r
4,4'-Methylenebisbenzeneamine	2.5E-01 h		2.5E-01 r		0	3.4E+00 ca	1.1E+01 ca	3.4E-02 ca	3.4E-01
4,4'-Methylene bis(2-chloroaniline)	1.3E-01 h	7.0E-04 h	1.3E-01 h	7.0E-04 r	0	6.6E+00 ca**	2.2E+01 ca*	6.6E-02 ca	6.6E-01
4,4'-Methylene bis(N,N'-dimethyl)aniline	4.6E-02 i		4.6E-02 r		0	1.9E+01 ca	6.2E+01 ca	1.9E-01 ca	1.9E+00
Methylene bromide		1.0E-02 h		1.0E-02 r	0	3.9E+02 nc	1.0E+04 nc	3.7E+01 nc	3.7E+02
Methylene chloride	7.5E-03 i	6.0E-02 i	1.6E-03 i	8.6E-01 h	1	2.2E+01 ca	3.9E+01 ca	5.2E+00 ca	6.2E+00
Methyl ethyl ketone		6.0E-01 i		2.9E-01 i	1	5.2E+03 sat	5.2E+03 sat	1.0E+03 nc	2.5E+03

Key: i=IR HEAST e=ECAO x=WITHDRAWN r=ROUTE EXTRAP. t=TOX. EQUIV. ca=CA RG nc=NONCANCER PRG sat=SOIL SAT. max=MAX. LIMIT *=nc < 100X ca =nc < 10X ca

CONTAMINANT	TOXICITY VALUES				V	PRELIMINARY REMEDIATION GOALS (PRGS)			
	oSF 1/(mg/kg-d)	oRfD (mg/kg-d)	iSF 1/(mg/kg-d)	iRfD (mg/kg-d)	O C	Residential Soil (mg/kg)	Industrial Soil (mg/kg)	Ambient Air (ug/m3)	Tap Water (ug/l)
Nitroguanidine		1.0E-01 i		1.0E-01 r	0	3.9E+03 nc	1.0E+05 nc	3.7E+02 nc	3.7E+03 n
4-Nitrophenol					0				
2-Nitropropane	9.4E+00 r	5.7E-03 r	9.4E+00 h	5.7E-03 i	1			9.1E-04 ca	4.4E+01 c
N-Nitrosodi-n-butylamine	5.4E+00 i		5.6E+00 i		0	1.6E-01 ca	5.3E-01 ca	1.5E-03 ca	1.6E-02 c
N-Nitrosodiethanolamine	2.8E+00 i		2.8E+00 r		0	3.0E-01 ca	1.0E+00 ca	3.0E-03 ca	3.0E-02 c
N-Nitrosodiethylamine	1.5E+02 i		1.5E+02 i		0	5.7E-03 ca	1.9E-02 ca	5.7E-05 ca	5.7E-04 c
N-Nitrosodimethylamine	5.1E+01 i		4.9E+01 i		0	1.7E-02 ca	5.6E-02 ca	1.7E-04 ca	1.7E-03
N-Nitrosodiphenylamine	4.9E-03 i		4.9E-03 r		0	1.7E+02 ca	5.8E+02 ca	1.7E+00 ca	1.7E+01
N-Nitroso di-n-propylamine	7.0E+00 i		7.0E+00 r		0	1.2E-01 ca	4.1E-01 ca	1.2E-03 ca	1.2E-02
N-Nitroso-N-methylethylamine	2.2E+01 i		2.2E+01 r		0	3.9E-02 ca	1.3E-01 ca	3.9E-04 ca	3.9E-03
N-Nitrosopyrrolidine	2.1E+00 i		2.1E+00 i		0	4.1E-01 ca	1.4E+00 ca	4.0E-03 ca	4.1E-02
m-Nitrotoluene		1.0E-02 h		1.0E-02 r	0	3.9E+02 nc	1.0E+04 nc	3.7E+01 nc	3.7E+02
p-Nitrotoluene		1.0E-02 h		1.0E-02 r	0	3.9E+02 nc	1.0E+04 nc	3.7E+01 nc	3.7E+02
Norflurazon		4.0E-02 i		4.0E-02 r	0				
NuStar		7.0E-04 i		7.0E-04 r	0	2.7E+01 nc	7.2E+02 nc	2.6E+00 nc	2.6E+01
Octabromodiphenyl ether		3.0E-03 i		3.0E-03 r	0	1.2E+02 nc	3.1E+03 nc	1.1E+01 nc	1.1E+02
Octahydro-1357-tetranitro-1357- tetrazocine (HMX)		5.0E-02 i		5.0E-02 r	0	2.0E+03 nc	5.1E+04 nc	1.8E+02 nc	1.8E+03
Octamethylpyrophosphoramide		2.0E-03 h		2.0E-03 r	0	7.8E+01 nc	2.0E+03 nc	7.3E+00 nc	7.3E+01
Oryzalin		5.0E-02 i		5.0E-02 r	0	2.0E+03 nc	5.1E+04 nc	1.8E+02 nc	1.8E+03
Oxadiazon		5.0E-03 i		5.0E-03 r	0	2.0E+02 nc	5.1E+03 nc	1.8E+01 nc	1.8E+02
Oxamyl		2.5E-02 i		2.5E-02 r	0	9.8E+02 nc	2.6E+04 nc	9.1E+01 nc	9.1E+02
Oxyfluorfen		3.0E-03 i		3.0E-03 r	0	1.2E+02 nc	3.1E+03 nc	1.1E+01 nc	1.1E+02
Paclobutrazol		1.3E-02 i		1.3E-02 r	0	5.1E+02 nc	1.3E+04 nc	4.7E+01 nc	4.7E+02
Paraquat		4.5E-03 i		4.5E-03 r	0	1.8E+02 nc	4.6E+03 nc	1.6E+01 nc	1.6E+02
Parathion		6.0E-03 h		6.0E-03 r	0	2.3E+02 nc	6.1E+03 nc	2.2E+01 nc	2.2E+02
Pebulate		5.0E-02 h		5.0E-02 r	0	2.0E+03 nc	5.1E+04 nc	1.8E+02 nc	1.8E+03
Pendimethalin		4.0E-02 i		4.0E-02 r	0	1.6E+03 nc	4.1E+04 nc	1.0E+09 nc	1.5E+03
Pentabromo-6-chloro cyclohexane	2.3E-02 h		2.3E-02 r		0	3.7E+01 ca	1.2E+02 ca	3.7E-01 ca	3.7E+00
Pentabromodiphenyl ether		2.0E-03 i		2.0E-03 r	0	7.8E+01 nc	2.0E+03 nc	7.3E+00 nc	7.3E+01
Pentachlorobenzene		8.0E-04 i		8.0E-04 r	0	3.1E+01 nc	8.2E+02 nc	2.9E+00 nc	2.9E+01
Pentachloronitrobenzene	2.6E-01 h	3.0E-03 i	2.6E-01 r	3.0E-03 r	0	3.3E+00 ca*	1.1E+01 ca	3.3E-02 ca	3.3E-01
Pentachlorophenol	1.2E-01 i	3.0E-02 i	1.2E-01 r	3.0E-02 r	0	7.1E+00 ca	2.4E+01 ca	7.1E-02 ca	7.1E-01
Permethrin		5.0E-02 i		5.0E-02 r	0	2.0E+03 nc	5.1E+04 nc	1.8E+02 nc	1.8E+03

Key: i=IRIS h=HEAST e=ECAO x=WITHDRAWN r=ROUTE EXTRAP. t=TOX. EQUIV. ca=CANCER PRG nc=NONCANCER PRG sat=SOIL SAT. max=MAX. LIMIT *=nc < 100X ca **=nc < 10X ca

CONTAMINANT	TOXICITY VALUES oSF 1/(mg/kg-d)	oRfD (mg/kg-d)	iSF 1/(mg/kg-d)	iRfD (mg/kg-d)	VOC	PRELIMINARY REMEDIATION GOALS (PRGS) Residential Soil (mg/kg)	Industrial Soil (mg/kg)	Ambient Air (ug/m3)	Tap Water (ug/l)
Prochloraz	1.5E-01 i	9.0E-03 i	1.5E-01 r	9.0E-03 r	0	3.5E+02 ca	9.2E+03 ca	5.7E-02 ca	3.3E+02 ca
Profluralin		6.0E-03 h		6.0E-03 r	0	2.3E+02 nc	8.1E+03 nc	2.2E+01 nc	2.2E+02 nc
Prometon		1.5E-02 i		1.5E-02 r	0	5.9E+02 nc	1.5E+04 nc	5.5E+01 nc	5.5E+02 nc
Prometryn		4.0E-03 i		4.0E-03 r	0	1.6E+02 nc	4.1E+03 nc	1.5E+01 nc	1.5E+02 nc
Pronamide		7.5E-02 i		7.5E-02 r	0	2.9E+03 nc	7.7E+04 nc	2.7E+02 nc	2.7E+03 nc
Propachlor		1.3E-02 i		1.3E-02 r	0	5.1E+02 nc	1.3E+04 nc	4.7E+01 nc	4.7E+02 nc
Propanil		5.0E-03 i		5.0E-03 r	0	2.0E+02 nc	5.1E+03 nc	1.8E+01 nc	1.8E+02 nc
Propargite		2.0E-02 i		2.0E-02 r	0	7.8E+02 nc	2.0E+04 nc	7.3E+01 nc	7.3E+02 nc
Propargyl alcohol		2.0E-03 i		2.0E-03 r	0	7.8E+01 nc	2.0E+03 nc	7.3E+00 nc	7.3E+01 nc
Propazine		2.0E-02 i		2.0E-02 r	0	7.8E+02 nc	2.0E+04 nc	7.3E+01 nc	7.3E+02 nc
Propham		2.0E-02 i		2.0E-02 r	0	7.8E+02 nc	2.0E+04 nc	7.3E+01 nc	7.3E+02 n
Propiconazole		1.3E-02 i		1.3E-02 r	0	5.1E+02 nc	1.3E+04 nc	4.7E+01 nc	1.0E-09 n
Propylene glycol		2.0E+01 h		2.0E+01 r	0	1.0E+05 max	1.0E+05 max	7.3E+04 nc	7.3E+05 n
Propylene glycol, monoethyl ether		7.0E-01 h		7.0E-01 r	0	2.7E+04 nc	1.0E+05 max	2.6E+03 nc	2.6E+04 n
Propylene glycol, monomethyl ether		7.0E-01 h		5.7E-01 i	0	2.7E+04 nc	1.0E+05 max	2.1E+03 nc	2.6E+04 n
Propylene oxide	2.4E-01 i	8.6E-03 r	1.3E-02 i	8.6E-03 i	1			6.6E-01 ca	2.9E-01 c
Pursuit		2.5E-01 i		2.5E-01 r	0	9.8E+03 nc	1.0E+05 max	9.1E+02 nc	9.1E+03 n
Pydrin		2.5E-02 i		2.5E-02 r	0	9.8E+02 nc	2.6E+04 nc	9.1E+01 nc	9.1E+02 n
Pyridine		1.0E-03 i		1.0E-03 r	0	3.9E+01 nc	1.0E+03 nc	3.6E+00 nc	3.7E+01 n
Quinalphos		5.0E-04 i		5.0E-04 r	0	2.0E+01 nc	5.1E+02 nc	1.8E+00 nc	1.8E+01 n
Quinoline	1.2E+01 h		1.2E+01 r		0	7.1E-02 ca	2.4E-01 ca	7.1E-04 ca	7.1E-03 c
RDX (Cyclonite)	1.1E-01 i	3.0E-03 i	1.1E-01 r	3.0E-03 r	0	7.7E+00 ca	2.6E+01 ca	7.7E-02 ca	7.7E-01 c
Resmethrin		3.0E-02 i		3.0E-02 r	0	1.2E+03 nc	3.1E+04 nc	1.1E+02 nc	1.1E+03
Ronnel		5.0E-02 h		5.0E-02 r	0	2.0E+03 nc	5.1E+04 nc	1.8E+02 nc	1.8E+03
Rotenone		4.0E-03 i		4.0E-03 r	0	1.6E+02 nc	4.1E+03 nc	1.5E+01 nc	1.5E+02
Savey		2.5E-02 i		2.5E-02 r	0	9.8E+02 nc	2.6E+04 nc	9.1E+01 nc	9.1E+02
Selenious Acid		5.0E-03 i			0	3.9E+02 nc	1.0E+04 nc		1.8E+02
Selenium		5.0E-03 i			0	3.9E+02 nc	1.0E+04 nc		1.8E+02
Selenourea		5.0E-03 h			0	3.9E+02 nc	1.0E+04 nc		1.8E+02
Sethoxydim		9.0E-02 i		9.0E-02 r	0	3.5E+03 nc	9.2E+04 nc	3.3E+02 nc	3.3E+03
Silver and compounds		5.0E-03 i			0	3.9E+02 nc	1.0E+04 nc		1.8E+02
Simazine	1.2E-01 h	5.0E-03 i	1.2E-01 r	2.0E-03 r	0	7.1E+00 ca*	2.4E+01 ca*	7.1E-02 ca	7.1E-01
Sodium azide		4.0E-03 i		4.0E-03 r	0	1.6E+02 nc	4.1E+03 nc	1.5E+01 nc	1.5E+02

Key: i=IRI HEAST e=ECAO x=WITHDRAWN r=ROUTE EXTRAP. t=TOX. EQUIV. ca=CAN RG nc=NONCANCER PRG sat=SOIL SAT. max=MAX. LIMIT *=nc < 100X ca =nc < 10X ca

CONTAMINANT	TOXICITY VALUES oSF 1/(mg/kg-d)	oRfD (mg/kg-d)	iSF 1/(mg/kg-d)	iRfD (mg/kg-d)	VOC	PRELIMINARY REMEDIATION GOALS (PRGS) Residential Soil (mg/kg)	Industrial Soil (mg/kg)	Ambient Air (ug/m3)	Tap Water (ug/l)
Thiram		5.0E-03 i		5.0E-03 r	0	2.0E+02 nc	5.1E+03 nc	1.8E+01 nc	1.8E+02 n
Tin and compounds		6.0E-01 h			0	4.7E+04 nc	1.0E+05 max		2.2E+04 n
Toluene		2.0E-01 i		1.1E-01 h	1	2.8E+02 sat	2.8E+02 sat	4.0E+02 nc	9.3E+02 n
Toluene-2,4-diamine	3.2E+00 h		3.2E+00 r		0	2.7E-01 ca	8.9E-01 ca	2.7E-03 ca	2.7E-02 c
Toluene-2,5-diamine		6.0E-01 h		6.0E-01 r	0	2.3E+04 nc	1.0E+05 max	2.2E+03 nc	2.2E+04 n
Toluene-2,6-diamine		2.0E-01 h		2.0E-01 r	0	7.8E+03 nc	1.0E+05 max	7.3E+02 nc	7.3E+03 n
Toxaphene	1.1E+00 i		1.1E+00 i		0	7.7E-01 ca	2.6E+00 ca	7.6E-03 ca	7.7E-02 c
Tralomethrin		7.5E-03 i		7.5E-03 r	0	2.9E+02 nc	7.7E+03 nc	2.7E+01 nc	2.7E+02 n
Triallate		1.3E-02 i		1.3E-02 r	0	5.1E+02 nc	1.3E+04 nc	4.7E+01 nc	4.7E+02 n
Triasulfuron		1.0E-02 i		1.0E-02 r	0	3.9E+02 nc	1.0E+04 nc	3.7E+01 nc	3.7E+02 n
1,2,4-Tribromobenzene		5.0E-03 i		5.0E-03 r	0	2.0E+02 nc	5.1E+03 nc	1.8E+01 nc	1.8E+02 r
Tributyltin oxide (TBTO)		3.0E-05 i		3.0E-05 r	0	1.2E+00 nc	3.1E+01 nc	1.1E-01 nc	1.1E+00 r
2,4,6-Trichloroaniline	3.4E-02 h		3.4E-02 r		0	2.5E+01 ca	8.4E+01 ca	2.5E-01 ca	2.5E+00 c
2,4,6-Trichloroaniline hydrochloride	2.9E-02 h		2.9E-02 r		0	2.9E+01 ca	9.9E+01 ca	2.9E-01 ca	2.9E+00 c
1,2,4-Trichlorobenzene		1.0E-02 i		2.6E-03 h	1	5.5E+02 sat	5.5E+02 sat	9.4E+00 nc	2.3E+01 r
1,1,1-Trichloroethane		9.0E-02 h		2.9E-01 x	1	3.0E+02 sat	3.0E+02 sat	1.0E+03 nc	1.5E+03 r
1,1,2-Trichloroethane	5.7E-02 i	4.0E-03 i	5.6E-02 i	4.0E-03 r	1	2.9E+00 ca	5.1E+00 ca	1.5E-01 ca	3.2E-01 c
Trichloroethylene (TCE)	1.1E-02 e	6.0E-03 e	6.0E-03 e	6.0E-03 r	1	1.4E+01 ca*	2.5E+01 ca*	1.4E+00 ca*	2.5E+00 c
Trichlorofluoromethane		3.0E-01 i		2.0E-01 h	1	4.1E+02 sat	4.1E+02 sat	7.3E+02 nc	1.7E+03 r
2,4,5-Trichlorophenol		1.0E-01 i		1.0E-01 r	0	9.3E-01 sat	9.3E-01 sat	3.7E+02 nc	3.7E+03 r
2,4,6-Trichlorophenol	1.1E-02 i		1.1E-02 i		0	7.7E+01 ca	2.6E+02 ca	7.8E-01 ca	7.7E+00 c
2,4,5-Trichlorophenoxyacetic Acid		1.0E-02 i		1.0E-02 r	0	3.9E+02 nc	1.0E+04 nc	3.7E+01 nc	3.7E+02 r
2-(2,4,5-Trichlorophenoxy) propionic acid		8.0E-03 i		8.0E-03 r	0	3.1E+02 nc	8.2E+03 nc	2.9E+01 nc	2.9E+02 r
1,1,2-Trichloropropane		5.0E-03 i		5.0E-03 r	1	3.1E+02 sat	3.1E+02 sat	1.8E+01 nc	3.8E+01 r
1,2,3-Trichloropropane	2.7E+00 e	6.0E-03 i	2.7E+00 r	5.0E-03 r	1	3.1E+02 sat	3.1E+02 sat	3.2E-03 ca	4.0E+01 c
Ethyl acetate					0				
1,2,3-Trichloropropene		5.0E-03 h		5.0E-03 r	1	3.0E+02 sat	3.0E+02 sat	1.8E+01 nc	3.8E+01 r
1,1,2-Trichloro-1,2,2-trifluoroethane		3.0E+01 i		8.6E+00 h	1	4.1E+02 sat	4.1E+02 sat	3.1E+04 nc	7.8E+04 r
Tridiphane		3.0E-03 i		3.0E-03 r	0	1.2E+02 nc	3.1E+03 nc	1.1E+01 nc	1.1E+02
Triethylamine		2.0E-03 r		2.0E-03 i	1	8.6E+01 nc	1.2E+02 nc	7.3E+00 nc	1.5E+01
Trifluralin	7.7E-03 i	7.5E-03 i	7.7E-03 r	7.5E-03 r	0	1.1E+02 ca**	3.7E+02 ca*	1.1E+00 ca*	1.1E+01
Trimethyl phosphate	3.7E-02 h		3.7E-02 r		0	2.3E+01 ca	7.7E+01 ca	2.3E-01 ca	2.3E+00 r

Key: i=IRIS h=HEAST e=ECAO x=WITHDRAWN r=ROUTE EXTRAP. t=TOX. EQUIV. ca=CANCER PRG nc=NONCANCER PRG sat=SOIL SAT. max=MAX. LIMIT *=nc < 100X ca **=nc < 10X ca

APPENDIX B

DETERMINATION OF REMEDIATION GOALS IN SOIL AND GROUNDWATER

Table B-1

List of Chemicals of Potential Concern in Soils and Potential Applicable or Relevant and Appropriate Requirements (ARARs) and Other Potential Criteria to be Considered Williams Air Force Base

Chemical of Potential Concern	Arizona Health-Based Soil Guidance Level[a] (mg/kg)	Risk-Based Calculated Allowable Concentration in Soil (mg/kg)	Background Levels in Soil[b] (mg/kg)	Location(s)
Acetone	12,000	5,490	----	FT-02 SD-10 ST-08 DP-13 SS-01
Alpha-Chlordane	1.0[c]	0.246	----	LF-04
Benzene	47	0.512	----	FT-02
Benzoic Acid	NA[d]	110,000	----	ST-08
Benzyl Alcohol	35,000	8,240	----	ST-08
Beta-BHC	0.76	0.178	----	LF-04
bis(2-ethylhexyl)phthalate	97	22.9	----	LF-04 FT-02 SD-10 SD-09 ST-08 DP-13
Chloroform	220 220	0.074 0.219	---- ----	FT-02 SD-10
Chrysene	0.11	NA[d]	0.078 - 0.64	ST-08
4,4'-DDD	5.7	1.34	----	LF-04
4,4'-DDE	4.0	0.942	----	LF-04
4,4'-DDT	4.0	0.942	----	LF-04
1,2-Dichlorobenzene	10,000	2,470	----	FT-02
1,4-Dichlorobenzene	1,200	13.4	----	LF-04 FT-02
Dieldrin	0.09	0.02	----	LF-04
Diethylphthalate	94,000	22,000	----	LF-04 ST-08 SS-01 SD-09

Table B-1

Chemical of Potential Concern	Arizona Health-Based Soil Guidance Level[a] (mg/kg)	Risk-Based Calculated Allowable Concentration in Soil (mg/kg)	Background Levels in Soil[b] (mg/kg)	Location(s)
Dimethylphthalate	NA[e]	27,500	----	SD-09
Di-n-butylphthalate	12,000	2,330	----	LF-04 ST-08 SS-01 SD-09
Di-n-octylphthalate	NA[e]	549	----	SD-09
Ethyl alcohol	NA[e]	NA[e]	----	SD-09
Ethyl benzene	12,000	4,940	----	FT-02 SS-01 ST-05 ST-06
Gamma-chlordane	1.0[c]	0.246	----	LF-04
Methyl ethyl ketone	5,800	742	----	FT-02
Methylene chloride	180	1.86 5.49 32.4 56.2 75.8	---- ---- ---- ---- ----	FT-02 SD-10 SS-01 ST-07 ST-08
4-Methylphenol	NA[d]	NA[d]	----	ST-08
Pentachlorophenol	11	2.67	----	LF-04
Phenanthrene	NA[d]	NA[d]	----	ST-08
Phenol	70,000	16,500	----	SD-09 SD-10 DP-13
Pyrene	3,500	824	----	SD-09
Tetrachloroethene	27	12.6	____	ST-08
Toluene	23,000 23,000 23,000 23,000 23,000	11,000 11,000 8.85 17.4 11,000	---- ----	FT-02 SD-10 SD-09 DP-13 ST-05
1,2,4-Trichlorobenzene	150	35.7	----	LF-04

Table B-1

Chemical of Potential Concern	Arizona Health-Based Soil Guidance Level[a] (mg/kg)	Risk-Based Calculated Allowable Concentration in Soil (mg/kg)	Background Levels in Soil[b] (mg/kg)	Location(s)
Xylenes	230,000	4,870 85,600 65,700 110,000 110,000	---- ---- ----	Ft-02 SS-01 ST-05 ST-06 ST-08
Antimony	47	31.3	<1	SD-09 SD-10 DP-13 ST-08
Beryllium	0.32	0.212	1.0 - 1.5	LF-04 SD-09 SD-10 SS-01
Cadmium	58	14.0	----	LF-04 FT-02 SD-09 SD-10 SS-01 ST-08
Chromium (Total)	1,700	2.08	15 - 100	SD-09
Copper	22,000	2,900	15 - 200	SS-01
Cyanide	2,600	1,560	----	ST-08
Lead	84	54.8	10 - 100	SD-09
Mercury	35	23.5	0.01 - 0.48	FT-02
Silver	840	235	----	SD-09 SD-10 SS-01
Thallium	8.2	5.48	----	LF-04
Zinc	23,000	15,600	25 - 150	LF-04 SD-09

Table B-1

[a] From: Arizona Department of Environmental Quality, Guidance Levels for Contaminants in Drinking Water and Soil, June 1992.
[b] Background concentrations of metals for the Phoenix area taken from "Element Concentrations in Solid and Other Surficial Materials of the Conterminous United States," USGS Geological Survey Professional Paper 1270, 1984. PAH background in surface soils from ATSDR, 1989.
[c] Value based on Chlordane.
[d] No EPA approved toxicity information is available for developing an action level for this compound.
[e] USGS, 1991.

LF-04 = Landfill
FT-03 = Fire Protection Training Area No. 1
SD-10 = Northwest Drainage Area
DP-13 = Pesticide Burial Area
SS-01 = Hazardous Materials Storage Area
ST-05 = Underground Storage Tanks at Building 789
ST-06 = Underground Storage Tanks at Building 725
ST-07 = Underground Storage Tanks at Building 1086
ST-08 = Underground Storage Tanks at Building 1085

Table B-2

Chemicals of Potential Concern in Soils and Remediation Goals (RGs)
Williams Air Force Base

Chemical of Potential Concern	RGs[a] Criteria To Be Considered (mg/kg)	Citation	Location(s)
Acetone	5,490	USAF Risk-Based Allowable Concentration	SD-10
	5,490	USAF Risk-Based Allowable Concentration	DP-13
	5,490	USAF Risk-Based Allowable Concentration	SS-01
	5,490	USAF Risk-Based Allowable Concentration	ST-08
Alpha-chlordane	0.246	USAF Risk-Based Allowable Concentration	LF-04
Benzoic Acid	110,000	USAF Risk-Based Allowable Concentration	ST-08
Benzyl Alcohol	8,240	USAF Risk-Based Allowable Concentration	ST-08
Beta-BHC	0.178	USAF Risk-Based Allowable Concentration	LF-04
bis(2-ethylhexyl)phthalate	22.9	USAF Risk-Based Allowable Concentration	LF-04
	22.9	USAF Risk-Based Allowable Concentration	SD-10
	22.9	USAF Risk-Based Allowable Concentration	DP-13
	22.9	USAF Risk-Based Allowable Concentration	ST-08
Chloroform	0.219	USAF Risk-Based Allowable Concentration	SD-10
Chrysene	43	USAF Risk-Based Allowable Concentration	FT-03 ST-08
4,4'-DDD	1.34	USAF Risk-Based Allowable Concentration	LF-04
4,4'-DDE	0.942	USAF Risk-Based Allowable Concentration	LF-04
4,4'-DDT	0.942	USAF Risk-Based Allowable Concentration	LF-04
1,4-Dichlorobenzene	13.4	USAF Risk-Based Allowable Concentration	LF-04
Dieldrin	0.02	USAF Risk-Based Allowable Concentration	LF-04
Diethylphthalate	22,000	USAF Risk-Based Allowable Concentration	LF-04
	22,000	USAF Risk-Based Allowable Concentration	SS-01
	22,000	USAF risk-based allowable concentration	ST-08
Di-n-butylphthalate	2,330	USAF Risk-Based Allowable Concentration	LF-04
	2,330	USAF Risk-Based Allowable Concentration	SS-01
	2,330	USAF Risk-Based Allowable Concentration	ST-08
Ethyl benzene	4,940	USAF Risk-Based Allowable Concentration	SS-01
	4,940	USAF Risk-Based Allowable Concentration	ST-05
	4,940	USAF Risk-Based Allowable Concentration	ST-06

Table B-2

Chemical of Potential Concern	RGs[a] Criteria To Be Considered (mg/kg)	Citation	Location(s)
Gamma-chlordane	0.246	USAF Risk-Based Allowable Concentration	LF-04
Methylene chloride	5.49	USAF Risk-Based Allowable Concentration	SD-10
	32.4	USAF Risk-Based Allowable Concentration	SS-01
	56.2	USAF Risk-Based Allowable Concentration	ST-07
	75.8	USAF Risk-Based Allowable Concentration	ST-08
4-Methylphenol	NA[b]		ST-08
Pentachlorophenol	2.67	USAF Risk-Based Allowable Concentration	LF-04
Phenanthrene	NA[b]		ST-08
Phenol	16,500	USAF Risk-Based Allowable Concentration	SD-10
	16,500	USAF Risk-Based Allowable Concentration	DP-13
Tetrachloroethene	12.6	USAF Risk-Based Allowable Concentration	ST-08
Toluene	11,000	USAF Risk-Based Allowable Concentration	SD-10
	17.4	USAF Risk-Based Allowable Concentration	DP-13
	11,000	USAF Risk-Based Allowable Concentration	ST-05
1,2,4-Trichlorobenzene	35.7	USAF Risk-Based Allowable Concentration	LF-04
Xylenes	85,600	USAF Risk-Based Allowable Concentration	SS-01
	65,700	USAF Risk-Based Allowable Concentration	ST-05
	110,000	USAF Risk-Based Allowable Concentration	ST-06
	110,000	USAF Risk-Based Allowable Concentration	ST-08
Antimony	31.3	USAF Risk-Based Allowable Concentration	SD-10
	31.3	USAF Risk-Based Allowable Concentration	DP-13
	31.3	USAF Risk-Based Allowable Concentration	ST-08
Beryllium	1.2	Background Concentration	LF-04
	1.2	Background Concentration	SD-10
	1.2	Background Concentration	SS-01
Cadmium	14.0	USAF Risk-Based Allowable Concentration	LF-04
	14.0	USAF Risk-Based Allowable Concentration	SD-10
	14.0	USAF Risk-Based Allowable Concentration	SS-01
	14.0	USAF Risk-Based Allowable Concentration	ST-08
Copper	2,900	USAF Risk-Based Allowable Concentration	SS-01
Cyanide	1,560	USAF Risk-Based Allowable Concentration	ST-08
Silver	235	USAF Risk-Based Allowable Concentration	SD-10
	235	USAF Risk-Based Allowable Concentration	SS-01

Table B-2

Chemical of Potential Concern	RGs[a] Criteria To Be Considered (mg/kg)	Citation	Location(s)
Thallium	5.48	USAF Risk-Based Allowable Concentration	LF-04
Zinc	15,600	USAF Risk-Based Allowable Concentration	LF-04

[a] These RGs apply to both soil treatment standards and final in situ standards
[b] No EPA approved toxicity information is available for developing an RG for this compound.

LF-04 = Landfill
FT-03 = Fire Protection Training Area No. 1
SD-10 = Northwest Drainage Area
DP-13 = Pesticide Burial Area
SS-01 = Hazardous Materials Storage Area
ST-05 = Underground Storage Tanks at Building 789
ST-06 = Underground Storage Tanks at Building 725
ST-07 = Underground Storage Tanks at Building 1086
ST-08 = Underground Storage Tanks at Building 1085

Table B-3

List of Contaminants of Potential Concern in Groundwater and Applicable or Relevant and Appropriate Requirements (ARARs) and Other Criteria to be Considered (all values are µg/L) Williams Air Force Base

(Page 1 of 2)

Chemical of Potential Concern	ARARs				Other Criteria To Be Considered (TBC)				
	Federal MCL[a]	Federal MCLG	Arizona MCL[b]	Aquifer Water Quality Standards[c]	Federal Proposed MCL	Federal Proposed MCLG	Arizona Health-Based Guidance Level[d]	Risk-Based Calculated Allowable Concentration in Groundwater	Background Levels in Groundwater[e]
Acetone							700	3,650	
Benzene	5.0		5.0	5.0			1.2	2.9	
bis(2-ethylhexyl)phthalate	6.0[f]	0[f]					2.5	6.1	
Bromide							NA[g]	NA[g]	
Bromodichloromethane	100		100				0.27	?	
Carbon disulfide							700	3,650	
Methylene chloride	5.0[f]	0[f]	NA[h]				4.7	11	
Tetrachloroethene	5.0	0	NA[h]	5.0			0.7	2.0	
Toluene	1,000	1,000	NA[h]	1,000			1,400	7,300	
Trichloroethene	3.2		3.2				120	7.7	
Antimony	6.0[f]	6.0[f]					2.8	15	
Beryllium							0.008	0.02	<1.0-7.0
Cadmium	5.0		5.0				3.5	18	<1.0
Chromium[d]	100[i]	100[i]	100[i]	100[j]			100[i]	180	<1.0-12
Copper	1,300[j]	1,300	N/A[h]	1,300	1,300[k]		1,300	1,350	<10-30
Lead	500	0	500	5.0	15[k]		5.0	26	<10-14
Manganese							700	3,650	<1.0-20
Nickel	100[f]	100[f]					140	730	
Nitrate	10,000		10,000				11,000	-----	1,470-33,800[l]
Selenium	50		50				50	180	1.0-3.0
Silver	50		50	50			50	110	
Uranium	20		20				21	110	
Zinc			NA[h]				1,400	7,300	<3.0-38

Table B-3

(Page 2 of 2)

[a] U.S. EPA, 40 CFR Parts 141, 142, 143, 1991.
[b] Arizona Aquifer Water Quality Standards, May 1992.
[c] ADEQ, Aquifer Water Quality Standards, to be enacted in early 1993.
[d] Arizona Human Health-Based Guidance Levels for Ingestion of Contaminants in Drinking Water and Soil, June 1992.
[e] USGS, 1992.
[f] New final drinking water standards effective January 1994, FR, July 17, 1992.
[g] No U.S. EPA-approved toxicity information is available for developing an RG for this compound.
[h] Monitor in accordance with R18-4-223.F and R18-4-223.B.5, Public and Semi-Public Water Supply Systems Rules, ADEQ, August 11, 1989.
[i] Total Chromium
[j] Not a source MCL - MCL is in distribution system.
[k] Federal treatment requirements effective December 7, 1992.
[l] Background nitrate data from Salt River Project Wells (See Appendix E of OU-1 Final FS Report)

ADEQ - Arizona Department of Environmental Quality
MCL - Maximum Contaminant Level
MCLG - Maximum Contaminant Level Goal

Table B-4

Chemical-Specific ARARs
List of Chemicals of Potential Concern in Groundwater and Remediation Goals (RGs)
Williams Air Force Base

Chemical of Potential Concern	RGs[a]			Citation
	Applicable (µg/L)	Relevant and Appropriate (µg/L)	Criteria To Be Considered (µg/L)	
Acetone			700	AZ HBGL
Benzene		5.0		Federal MCL
bis(2-ethylhexyl)phthalate			6.0	Federal MCL, effective January 1994
Bromide			NA[b]	
Bromodichloromethane		100		Federal MCL
Carbon disulfide			700	AZ HBGL
Methylene chloride			5.0	Federal MCL, effective January 1994
Tetrachloroethene		5.0		Federal MCL
Toluene		1000		Federal MCL
Trichloroethene		3.2		Federal MCL
Antimony			6.0	Federal MCL, effective January 1994
Beryllium			<1.0-7.0	Background concentrations
Cadmium		5.0		Federal MCL
Chromium (total)		100		Federal MCL
Copper			1,300	EPA OSWER June 24, 1990 (values effective December 1992)
Lead			15	EPA OSWER June 24, 1990 (values effective December 1992)
Manganese			700	AZ HBGL
Nickel			100	Federal MCL, effective January 1994
Nitrate			1,470-33,800	Background concentrations
Selenium		50		Federal MCL
Silver		50		Federal MCL
Zinc			1,400	AZ HBGL
Uranium		20		Federal MCL

[a] These RGs apply to both effluent treatment standards and final in situ standards.
[b] No EPA approved toxicity information is available for developing an RG for this compound.

APPENDIX C

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Table C-1

Location-Specific Applicable or Relevant and Appropriate Requirements
Williams Air Force Base

Location	Requirement(s)	Prerequisite(s)	Citation	Comments	A[a]	RAR[b]
Hazardous waste site	Actions to limit worker exposure to hazardous wastes or hazardous substances, including training and monitoring.	Construction, operations and maintenance, or other activities with potential worker exposure.	29 CFR 1910.120		B	
Historic project owned or controlled by Federal Agency	Action to preserve historic property; planning of action to minimize harm to National Historic Landmarks	Property included in or eligible for the National Register of Historic Places	National Historic Preservation Act, Section 106 (16 USC 470 et seq.); 36 CFR Part 800			B
Within area where action may cause irreparable harm, loss, or destruction of significant artifacts	Action to recover and preserve artifacts	Alteration of terrain that threatens significant scientific, prehistoric, historic, or archaeological data	National Archaeological and Historical Preservation Act (16 USC Section 469); 36 CFR Part 65			B

[a]Criteria is applicable for Alternatives A or B.
[b]Criteria is relevant and appropriate for Alternatives A or B.

Table C-2

Action-Specific Applicable or Relevant and Appropriate Requirements
Williams Air Force Base

(Page 1 of 3)

Action	Requirement(s)	Prerequisite(s)	Citation	Comments	A[a]	RAR[b]
Air Emissions Control During Remediation	Control of air emissions of volatile organics, particulates, and gaseous contaminants.	Emission of VOCs, particulates, and gaseous air contaminants	Maricopa County Air Quality Standards (Rules 200, 210, 220, 320) as dictated by the Clean Air Act		B	
Groundwater Well Installation, Development, Testing, and Sampling	Any nonwaste material (e.g., groundwater or soil) that contains a listed hazardous waste must be managed as if it were a hazardous waste.	Nonwaste material containing listed hazardous waste	RCRA "contained in" principle		B	
Groundwater Monitoring	Groundwater monitoring at new or existing RCRA disposal units.	Creation of a new disposal unit, remedial actions at an existing RCRA unit or disposal of RCRA hazardous waste.	40 CFR 264 - Subpart F			B
Surface Water Control	Prevent run-on and control and collect run-off from a 24-hour 25-year storm (land treatment facility).	RCRA hazardous waste treated, stored, or disposed after the effective date of the requirements.	40 CFR 264.301 (f)(g)			B

Table C-2

Action	Requirement(s)	Prerequisite(s)	Citation	Comments	A[a]	RAR[b]
Closure with Waste in Place	All contaminated equipment, structures and soils must be properly disposed of or decontaminated. File a survey plat with local zoning authority indicating the location and dimension of the landfill cell. File a post-closure notice with the Maricopa County Recorder's office that notifies potential buyers in perpetuity of the location of the landfill and restricted uses under 40 CFR Subpart G Installation of final cover (see Capping). 30-year post-closure care and groundwater monitoring.	Applicable to land disposal of hazardous waste. Applicable to RCRA hazardous waste (listed or characteristic) placed at site after the effective date of the requirements, or placed into another unit. Not applicable to material treated, stored, or disposed only before the effective date of the requirements, or if treated in-situ or consolidated within area of contamination.	40 CFR 264.114 40 CFR 264.116 40 CFR 264.119 40 CFR 264.310 40 CFR 264.310			B
Capping (See also Closure with Waste in Place for additional associated requirements)	Placement of a cap over waste requires a cover designed and constructed to: • Function with minimum maintenance; • Promote drainage and minimize erosion or abrasion of the cover; • Accommodate settling and subsidence so that the cover's integrity is maintained. Restrict post-closure use of property as necessary to prevent damage to the cover. Maintain the integrity and effectiveness of the final cover, including making repairs to the cap as necessary to correct the effects of settling, subsidence, erosion, or other events. Prevent run-on and run-off from damaging cover. Protect and maintain surveyed benchmarks used to locate landfill.	RCRA hazardous waste placed at site after the effective date of the requirements, or placement of hazardous waste into another unit will make requirements applicable when the waste is being covered with a cap for the purpose of leaving it behind after the remedy is completed. Capping without such placement will not make requirements applicable.	40 CFR 310(a) 40 CFR 264.117 (c) 40 CFR 264.310 (b)(1) 40 CFR 264.310 (b) 40 CFR 264.310 (b)			B

Table C-2

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Action	Requirement(s)	Prerequisite(s)	Citation	Comments	A[a]	RAR[b]
Container Storage (On-Site)	Containers of hazardous waste must be:	RCRA hazardous waste (listed or characteristic) held for a temporary period before treatment, disposal, or storage elsewhere. (40 CFR 264.10) in a container (i.e., any portable device in which a material is stored, transported, disposed of, or handled).		These requirements are applicable for any contaminated soil or groundwater or treatment system waste that might be containerized and stored on site prior to treatment or final disposal. Groundwater or soil containing a listed waste must be managed as if it were a hazardous waste so long as it contains the listed waste.	B	
	• Maintained to good condition		40 CFR 264.171			
	• Compatible with hazardous waste to be stored		40 CFR 264.172			
	• Closed during storage (except to add or remove waste)		40 CFR 264.173			
	Inspect container storage areas weekly for deterioration.		40 CFR 264.174			
	Place containers on sloped, crack-free base, and protect from contact with accumulated liquid. Provide containment system with a capacity of 10 percent of the volume of containers of free liquids.		40 CFR 264.175			
	Remove spilled or leaked waste in a timely manner to prevent overflow of the containment system.					
	Keep containers of ignitable or reactive waste at least 50 feet from the facility's property line.		40 CFR 264.176			
	Keep incompatible materials separate. Separate incompatible materials stored near each other by a dike or other barrier.		40 CFR 264.177			
	At closure, remove all hazardous waste and residues from the containment system, and decontaminate or remove all containers, liners.		40 CFR 264.178			
	Storage of banned wastes must be in accordance with 40 CFR 268. When such storage occurs beyond one year, the owner/operator bears the burden of proving that such storage is solely for the purpose of accumulating sufficient quantities to allow for proper recovery, treatment, and disposal.		40 CFR 268.50			

[a] Criteria is applicable for Alternatives A or B.
[b] Criteria is relevant and appropriate for Alternatives A or B.

APPENDIX D

COST ESTIMATES

Table D-1. Alternative A
NO ACTION COST ESTIMATE
Annual Operating and Maintenance Costs

Williams AFB
Project-409735.30.25.001
CS-TabD-1.xls - 08/30/93

	COST COMPONENT	UNIT COST ($)	UNIT	QUANTITY	UNITS / PERIOD	COST ($/year)
1.	Operating labor (a)	50	hour (hr)	136	hr/year	6,800
2.	Maintenance					NA
3.	Materials					NA
4.	Utilities					NA
5.	Disposal					NA
6.	Purchased services					
	Monitoring Soil Samples (20 samples)	10,200	sampling event	1	sampling/year event	10,200
	Monitoring Groundwater Samples (6 samples)	4404	sampling event	2	sampling/year events	8,800
7.	Administration					
	Data evaluation	70	hr	24	hr/ 6 months	3,400
	SUBTOTAL OPERATING COSTS					29,200
8.	Insurance, permits, taxes					NA
9.	Rehabilitation costs					NA
10.	Contingency	15% operating costs				4,400
11.	Periodic site review (b)					20,000
	TOTAL ANNUAL OPERATING COST (+50%, -30%)					53,600

a. Including 1 soil sampling event and 2 groundwater sampling events.
b. Every 5 years, cost shown is allocation for 1 year.
NA - not applicable

Table D-2. Alternative B
CAPPING COST ESTIMATE AT LF-04
Capital Costs

Williams AFB
Project-409735.30.23.002
CS-WOU1S4-03/22/93

COST COMPONENT	DESCRIPTION	COST ($)
DIRECT CAPITAL COSTS		
1. Site Preparation	Clearing and Grubbing 36.6 Acres	147,200
2. Capping	Soil Cover and Rubblized Concrete	1,914,200
3. Drainage Ditch	Interceptor Trench around perimeter	1,500
4. Fence	6751 Linear feet	88,100
TOTAL DIRECT COST (TDC)		2,151,000
INDIRECT CAPITAL COSTS		
1. Engineering and Design	15% TDC	322,700
2. License, permit, legal fees	2% TDC	43,000
3. Start-up	5% TDC	NA
4. Contingency	15% TDC	322,700
TOTAL INSTALLED COST (+50%, -30%)		2,839,400

NA - not applicable

Table D-3. Alternative B
CAPPING COST ESTIMATE AT LF-04
Annual Operating and Maintenance Costs

Williams AFB
Project-409735.30.23.001
CS-WOU1S4 - 03/22/93

	COST COMPONENT	UNIT COST ($)	UNIT	QUANTITY	UNITS / PERIOD	COST ($/year)
1.	Operating labor (a)	50	hour (hr)	72	hr/year	3,600
2.	Maintenance (2% TDC)					0
3.	Materials					NA
4.	Utilities					NA
5.	Disposal					NA
6.	Purchased services Monitoring Groundwater Samples (6 samples)	4404	sampling event	2	sampling/year events	8,800
7.	Administration Data evaluation	70	hr	24	hr/ 6 months	3,400
	SUBTOTAL OPERATING COSTS					15,800
8.	Insurance, permits, taxes					NA
9.	Rehabilitation costs					NA
10.	Contingency	15% operating costs				2,400
11.	Periodic site review (b)					20,000
	TOTAL ANNUAL OPERATING COST (+50%, -30%)					38,200